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ARCHAEOLOGY IN RAJASTHAN

Prof. H. D. SANKALIA

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Forward

Sahitya Sansthan has been organising the OJHA CHAIR LECTURES on the different aspects of history in the reverend memory of the great and illustrious historian Mahamahopadhyaya G.H. Ojha since 1941. These lectures on **Archaeology of Rajasthan** were also delivered by Prof. H.D. Sankalia under the auspices of the above chair.

The learned author of this book needs no introduction. He is an Archaeologist of international repute. He has put this state (Rajasthan) on the Archaeological map of India. The learned archaeologist tells us that Eastern Rajasthan is one of the oldest regions of India and of the world, because here we witness in its rocks almost the complete history of earth. The North Eastern and the Eastern Rajasthan in a sense, form part of the Indo-Gangetic plain and Malva plateau respectively. The North Western Rajasthan was drained by the Saraswati and Drishadvati which rise in the Himalayas and could carry water inspite of hostile natural forces within Rajasthan. He also tells us that the South Eastern Rajasthan is a source of history of man and its cultural development for more than a lac of years. Thus, his findings provide a unique personality to this state. In this way he also gives us an opportunity to delve into the recesses of his scholarly mind and replenish our knowledge of human development. It is hoped that these lectures shall provide the source-material to scholars to work on the pre and proto history of Rajasthan.

Sahitya Sansthan is a Research Institute and a constituent unit of Rajasthan Vidyapeeth, Udaipur (Deemed to-be University). It has been actively engaged in Research since 1941 in the field of History, Culture, Archaeology, Art-Architecture, Religion, Sanskrit, Prakrit, Apbhransh, Hindi-Rajasthani language and literature under the inspiring guidance and leadership of our Esteemed Vice-Chancellor, Manishi Pt. Janardan Rai Nagar. The Sansthan has a

valuable collection of old and rare manuscripts of Hindi-Rajasthani, Sanskrit and Apbhransha and also has a large number of Sculptors, epigraphs and coins. The Sansthan has so far published 74 books on above mentioned aspects. It has also to its credit a Quarterly Research Journal SHODH PATRIKA which is regularly coming out for the last 39 years.

Our heartiest regards for magnanimity of Manishi Pt. Janardan Rai Nagar, Vice-Chancellor, Rajasthan Vidyapeeth, Udaipur for providing us with a benevolent grant to publish these lectures. Here, I would like to offer my thanks to Prof. K. K Vashishtha, Director of Instruction and Registrar, Rajasthan Vidyapeeth, Udaipur for his kind cooperation and timely advice.

I offer my sinceriest regards to Prof. H.D. Sankalia, for delivering these lectures and to give us this opportunity to print them.

It is my moral duty to thank Prof. K. T. M. Hegde, Prof V. H. Sonavane, M. S. University of Baroda, Vadodara and Prof Craddock, Research laboratory, British Museum, London, WCIB 3 D.G. England for their contributions that are appended along with the published lectures.

I am grateful to shri B S. Garg, Kulpramukha, Rajasthan Vidyapeeth kul, Udaipur for providing the necessary facilities for organising these lectures.

I offer my thanks to Shri Madanlal Lahoti, Finance officer Rajasthan Vidyapeeth, Udaipur and Shri Uma Shankar Shukla, Adhyaksh, Sahitya Sansthan, Rajasthan Vidyapeeth, Udaipur for their cooperation. I am also thankful to Dr. Lalit Pandey Sahitya Sansthan, Rajasthan Vidyapeeth, Udaipur who prepared the Index.

I have also to record my thanks to Kachhara Printers for getting the book printed timely.

Dr. DEV KOTHARI
Director

Preface

It is a matter of great pleasure that Sahitya Sansthan Rajasthan Vidyapeeth, Udaipur is organising the extension lectures under the auspices of OJHA CHAIR.

I had an opportunity to deliver three lectures on "Archaeology in Rajasthan" which are brought out in this book. I extend my heartiest thanks to the authorities and workers of Sahitya Sansthan for publication of these lectures. I hope that it will be useful for research scholars interested particularly in the pre and proto history of Rajasthan.

Rajasthan unlike many other parts or states of India has played a very important part in the history of India. Until recently it was famous for the colourful dresses of their woman folk, and most artistic palaces.

Archaeology now has suddenly taken its history to dim prehistoric past, not only of South-Western Rajasthan but even of Central Rajasthan. Recent geographical studies have shown that owing to the Thar desert and vegetation. Hence the adivasis have continued to live as they did thousands of years ago. However South-Western Rajasthan owing to most genial climatic conditions and the discovery of copper and zinc had developed a civilization which the archaeological excavations have laid bare. This richness has also been confirmed by the discovery of arms and vessels of copper by Dr. R. C. Agarwal.

What is now necessary is a Socio-archaeological study which we had begun near Ahar.

H. D. SANKALIA

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The Scope Of Archaeology

The subject of these lectures is the archaeology of Rajasthan. Archaeology in its literal sense means only antiquities, or old object made by man (artifact). And for nearly 100 years when interest in archaeology was born, first in Europe; and much later in India old objects, portable or immovable.......such as images, and tamples, mosques and minarets, as well as small precious objects....were avidly collected and exhibited in private and public places. Thus were born the now world famous museums in England, France, Germany, and the Ajayabghars in India.

New Horizon

These individual and public collections often ignored the story that lay hidden behind the object. This narrow view of archaeology has gradually undergone a change, so much so that after the last war, archaeology is no longer regarded as only a branch of history, social sciences or humanities, but is also included under Science. Infact with the help of several scientific disciplines like physics, chemistry, geology, astronomy, archaeology now tells us the story of man, not only from the dim past, but of the environment in which man lived– that is, the climate, physical features of

the land, the food he ate, and the clothes he wore, and above all the time when he lived, even if very few actual objects of his daily life might have survived. For as I have explained at some length elsewhere, a modern archaeologist works above ground, under ground, in the air as well as in water (river or sea). And above all, he neglects nothing. Not only he collects, studies and appreciates an object of art, such a beautiful image, or a precious ornament of gold, diamond, or pearls, but values equally most insignificant things as bone, ash, the soil or earth he excavates, and the dried up faecal matter........called coprolite. For all these enable him to know the food or foods the man might have eaten thousands of years, ago and the climatic conditions under which he might have lived. Thus archaeology today has become all embracing.

Such being the scope of the subject, I would not tell you in a chronological order or a regional order the things that have been discovered in Rajasthan during the last 100 years or more. This would be the most uninsteresting and unenlightened way of dealing with the subject.

Reconstruction of the past life of Man

What one should aim at in the interpretation or the significance of the available knowledge in reconstructing the life and times of man, since he first appeared in Rajasthan, upto a period which can be reasonably covered in the course of three lectures, leaving the remaining period for a similar treatment in the future.

Brief Survey of work during the last century

Rajasthan was quite rich in its archaeological remains. During the last 10 years, not only has it been further enriched by new discoveries but its span which stretched back upto 2000 B.C. has now been taken back upto at least 100,000 years. Such a vast span cannot be adequately covered in three lectures. However, I will briefly review the important landmarks. These landmarks coincide fortunately with the progressive revelation of Rajasthan's past:—

I.	1861–1938–39	Historical (1860 A.D.–c.300 B.C.)
II.	1938–39–1953	Protohistoric (c.300 B.C.–c.2500 B.C.)
III.	1953–1968	Prehistoric (c.2500 B.C.–100,000 B.C)

During the first period it was General Cunningham and his assistants who by their explorations discovered the ruins of temples and other monuments. Their work was systematically followed by Henry Cousens, D. R. Bhandarkar, and R. D. Banerji. However, this was confined only to certain parts of Rajasthan. Parts of States like Jaipur and Bikaner were left out. Before the first world war Tesitore had explored the Bikaner desert. But a more systematic work began when Jaipur had its own Diretor of Archaeology. First the late Rai Bahadur Dayaram Sahani, and then Dr. K. N. Puri systematically carried out exploration in the State and also dug at Sambhar and Rairh.

However,no excavations of any kind were undertaken in Bikaner, Jodhpur, and Udaipur States and in the British territory of Ajmer. Anyway we had a faint picture of the life in Rajasthan going back upto 4th century B. C. with a

hint that elsewhere man might have existed in the region, much earlier as a solitary find from Bundi suggested.

However, by this time, that is 1938, the Indus Civilization had been well known. It was not confined to Mohenjodaro and Harappa. The late N.G. Majumdar had discovered its traces all over Sind, and Sir Aurel Stein had traced the remains of earlier and later cultures in Baluchistan and the Indo-Iranian borderland, and Madho Sarup Vats had just unearthed a site in Kathiawad (Saurashtra). Sir Aurel Stein rightly suspected that Rajasthan which adjoined Sind, and lay in between Sind and Saurashtra should contain the relics of the Indus Civilization and other unknown cultures. And his search in the dry beds of the ancient Sarasvati and Drishavati brought to light numerous Harappan or Indus Valley sites, and sites of other cultures.

Unfortunately Stein's report of his explorations in Bikaner and Bahwalpur States has never been published, nor also of Shri A. Ghosh who followed the clues supplied by Stein carried out further explorations in the former Bikaner State and brought to light numerous Harappan and later sites, now known as Cemetry-H Culture, Black-and-Red ware Culture, the Painted Grey ware Culture and the Rangmahal Culture.

There was little doubt now left that Northern Rajasthan had come under the spell of the Indus Civilization, what its nature was, had to be ascertained by an excavation. And this is being currently done at Kalibangan. Surprising as it would seem, this site and many others in the Sarasvati

Valley have revealed the existence of a still earlier culture, known by a prosaic name, pre-or proto-Harappan or kalibangan I.

Thus Northern Rajasthan was proved to be as old as Sind and the punjab. what about the rest-western Rajasthan and S.E. Rajasthan ?

Shri Ratanchand Agarwal's small excavations on the mighty mound at Ahad which is a part of Udaipur today showed that this part of Rajasthan was fairly old, if not as old as the Northern. Our Joint excavation later have indicated that Ahad was a copper smelting city–truly Tambavati as known in popular parlance, some 4000 years ago.

Explorations of the Archaeological Survey of India and Dr. V. N. Misra of the Deccan College,poona further showed that Ahad civilization was not confined to Udaipur, but extended to the districts of Chitorgarh, and Bhilwara, that is spread over all the tributaries of Banas. Again this was not quite uniform everywhere. Probably there were an earlier and slightly different stages of culture as shown in the small but unpublished excavation at Gilund.

Rajasthan's past was thus pushed back within one generation by some two thousand years. But was it this much only ? Could it not be still earlier, as Northern Gujrat and Malwa for instance, which in a sense were but continuation of South-east and Eastern Rajasthan ? For here the Deccan College had found earliest traces of man in the beds of the Sabarmati, and the mahi. If a clue was wanting it was given of Nathdwara in 1955. This was soon

followed up by member of the Archaeological Survey of India at Chitor and elsewhere in the valleys of the Berach and Gambhiri.

Only western Rajasthan remained. Could it be so old ? A lakh or two lakhs years old ? If so, when was it under the sea ? Planned surveys by Dr. Misra of the Deccan College in the Luni valley has proved that this region was know to man at least 30 to 40 thousand years ago, and had seen much better climatic conditions at that time than any time afterwards.

Cultural Divisions dependent of Physiography

It would be evident that the three principal divisions of Rajsthan viz. the Northern, Western and South-Eastern and Eastern had witnessed different kinds of cultural develop- ments. And this was largely due to its varied physiography. For geography has always had some influence or say in determining the cultural, social, political, economic-develop- ment of a country.

Of the geographical determinism, Rajasthan presents a good example, not only during prehistoric times, but even witnin the almost recent times. For what Rana Pratap and his ancestors and successors did, could not have been achieved at Jaipur which has only low hillocks around it, and much less in the open country of Jodhpur. Though in a larger sense the rulers of all these three States, by their unrivalled bravery, have served and will continue to serve as a beacon light for generations of Indians.

The Aravallis which bisect Rajasthan diagonally from southwest to northeast have therefore given Rajasthan an individuality, while they have also acted as barriers for an easy movement of men and ideas and goods from the north and west to the south and east, they have also been responsible for the steady growth and preservation of men and their ways of life, once they happen to be behind this barrier. This alone explains the long and unique character of the Ahad Culture, or the century-long resistance by the Ranas of Udaipur against the might of the Moghuls.

Still earlier almost at the dawn of history, man could find suitable raw material in the form of quartzite pebbles on the banks of Banas, the Berach and the Gambhiri,because these rivers flow through these rock formations and secondly water, game and edible roots and fruits were perennially available.

Western Rajasthan

This was not the case with western and most of Northern Rajasthan, except that portion forming part of the Aravallis on the northeast and the earliest Indogangetic plains. For according to our evidence from the Luni velley there was possibly no land where the Luni flows today, in Early or Middle Pleistocene times, that is some five and more lakhs years ago. For the kind of river deposits, (Pebbly graval) which we find in the South-eastern and Eastern Rajasthan have so far not been found in this rigion.Nor do we get these kinds of stone tools,-large handaxes, cleavers and pebble tools, which are met within South eastern Rajasthan. Prehistoric Archaeology therefore supports the view that Western

Rajasthan was once under the sea, but it also tells us that this was not in the very distant past, but some 40,000 years ago.

Once the land was formed, the rivers began to flow on it. There is definite evidence to say that this river flowed more regularly than the present Luni, throughout the historic times. That means that the rainfall was greater and more regular than today.

Probably the same is the story of much of Bikaner, and parts of Jaipur State, which are in the midst of deserts today. Hence it is that both these divisions of Rajasthan have received more influences-people and cultures from Sind, and Baluchistan, and the distant Iran, and western and Central Asia.

Southeastern Rajasthan was however not immune to foreign influences, though as I said above the Aravallis did pose an obstacle from the west. Not only these could be penetrated through natural passages-ghats, but the country opens out towards the northeast, through which the rivers Banas, the Berach, the Gambhiri flow and meet the Chambal, which in its turn meets the Yamuna. These rivers, we know were the great carriers of cultures right from prehistoric times both into and out of S.E.Rajasthan. It was two way passage. But owing to the peculiar physical and economic advantages offered by S.E. Rajasthan, man once having got into it was in blind alley-or *culde sac.* He preferred to remain there. Besides the hill fastnesses, fairly fertile plains, and there is

easily available building stone in the form of schist rock, and copper. The last, copper, seems to have been discovered in this region very early, at least 4000 years ago. In fact, as I have said elsewhere it was like a magnet which drew men to the Banas Valley and the beautiful surroundings of Udaipur. Even the quartz nodules which one notices in thousands scattered over the hills near Udaipur were put to use. It is not today that these quartz nodules are mixed with earth and cowdung to make the house walls firm and beautiful, but right from the earliest days of Ahad. Thus man has tried to make the best possible use of its environment.

In the north and west he had to be more receptive,as an open country has few barriers. The only barriers were the vast bleak and undefendable deserts. But these too produces a hardly adventurous band of people, who reared up in the hardships are willing to bear even more hardships elsewhere.

But in Rajasthan culture all made up by outsiders or foreigners ? Have the Adivasis- such as Bhils-no share in the make up of Rajasthan Cultures ? For once, according to the tradition, most of Southeast Rajasthan, today constituting the districts of Banswara, Bhilwara, Chitor and Udaipur were largely populated by the Bhils.

So a correlation of the Archaeological data with the ethnological and ethnographical is necessary. And an attempt was made at the Deccan College to understand this problem. I shall later refer to the result of our investigation.

Summary

Right from the earliest times we know of man's arrival or

existence in the land what is called Rajasthan, physiographic features have played an important part in giving rise to or moulding or helping in the development of cultures.

The two or three divisions of Rajasthan as known today have yielded varying evidence. In the formation of these cultures, Rajasthan's position has also contributed a great share. What was the share of the indigenous or aboriginal population now divided into Bhils, Minas has not yet been ascertained, but it should be considerable, if we remember the part played by the Bhils in helping Udaipur resisting Delhi, or even in the yearly ceremony at Shri Nathdwara.

Early Man And His Successors In Rajasthan

Archaeology is intimately connected with geology. The latter explains the development of man through his artifacts, and the former (archaeology) in its turn illumines the hitherto unknown facets of geology. This is very well illustrated in Rajasthan.

Eastern Rajasthan is one of the oldest regions of India and of the world, because here we witness in its rocks almost the complete history of earth. But this is not so in the Western and Northeastern Rajasthan. Geo-geologically, Western Rajasthan is comparatively recent. The sandstones of Jaisalmer, and the limestones tell us that this part of Rajasthan was once under the sea, not once but twice. And once the sea receded, it was thought that the wind and sand had taken over the land, and covered it with masses of sand from the Gulf of Kutch.

However, the old bed of the Luni hidden under the mantle of sand, and now known to contain the earliest relics of man prove that much before the sand and wind played its part, the region after it came up from the sea was

drained by the prehistoric Luni. This river was not 'Luni' (not brackish), because it flowed perennially, in a wider and higher bed, because of regular fall. This suitable environment had attracted man to settle on its banks. But when the climate changed, the region became inhospitable, some-western part around Jaisalmer-had gone under the sea,and the eastern covered by sand, man probably withdrew. It is a still a moot point, whether the traces of the Indus, or the pre and proto Indus cultures will be found in the Barmer and Jaisalmer area. So far none have been found, but if they are found in future the inference made by me would be proved wrong. But at present it helps us in distinguishing the cultural zones. Western Rajasthan became arid, and inhospitable for man. And much later when man progressed elsewhere and developed the art of digging well and construct wells and tanks, that man could think of returning to Jodhpur and that too as refugees. For otherwise it was Maru; the land of the dead, or the land that would lead to death, because of the scarcity of water.

Thus the archaeological history of Western Rajasthan is very discontinuous. So also of the Northwestern, but much better, because it was drained by the Sarasvati and Drishadvati which rise in the Himalayas and could carry water, inspite of hostile natural forces within Rajasthan.

The Northeastern, and Eastern Rajasthan in a sense form part of the Indo-Gangetic plain and Malwa plateau respectively. The former has been regarded, more than 2000 years ago, as very fertile (Bahudhanyadayaka). So here a

continuous and even a richer record than available in the southeastern will be had when it is adequately explored. As it is, it has yielded stray clues of Early Man, and his successors, right upto the dawn of historical period.

However, it is the Southeastern Rajasthan which has given us a continuous history of man and his cultural development, for more than a lakh (100,000) of years. Hence we shall take up this area first.

Early Man And His Successor in Rajasthan

The first man lived in the foothills of the Aravallis watered by the Banas and its tributaries, the Berach, the Gambhiri and others. He was a product of child of the Aravallis, and we might as well as call him the Aravalli Man, though it should be clearly understood that he was not as old as the Aravallis, which are the remnants of the oldest mountains in India and the world. Probably this Aravalli Man was not even the oldest in India.

How do we know this ? Have we got any tangible evidence for making such large, bold statement ? Yes ! At present the evidence is mainly archaeological and geological.

Following up the initial clue by a discovery at Nathdwara on the Banas and the later ones at Chitor, the rivers Banas, the Berach, the Gambhiri and the Wagan have been carefully examined by Dr. V. N. Misra, under my guidance. I have personally studied the important sactions at Nathdwara, Chitor, Nagari, Bigod and Hajikhera.

So from this 10-15 years of work from a comparative study of the material with other regions in India, we are able to have a reliable picture of Early Man and his environment around Udaipur, or say South - Eastern Rajasthan.

First, what was the country like when Man first appeared in the Aravallis ? Tha Aravallis, as you know, dominate the scene dividing Rajasthan in two unequal halves. These oldest mountains range in the world have considerably lost their height by denudation by wind and rain. The highest point Gurushikhar is only 4,500 ft. high now. But a couple of lakh years ago, it should have been still higher. From this towering height they gently slope eastwards and while the southwards, they have been steeply cut-up by the Mahi, Westwards the descend rather abruptly towards the Jodhpur plain. The scenery in the time we are discussing might or should have been considerably different. The northern and the eastern plains had not taken their present shape, while the south was probably not much cut up by ravines of gently sloping northern and eastern.

The Mahi plains have been formed by the alluvium of the Banas and other rivers, as well as by the Gangetic alluvium. These rivers now flow at a depth of about 30-40 ft. from the surface on the original gneissic bed. This bed they have exposed in comparative recent past. That means these are not the exact original beds of the rivers - Banas Berach, Wagon etc. Where were these rivers then ? And at what level they were flowing ? The first rivers

began to flow gneissic original gneissic, quartzite, schist, shale and sandstone and other rocks which form the crust of the land in southern Rajasthan.

At this time, the rain must have been much more heavy than at present, or at any time in the immediate past. For the first rivers, the Adya Banas carried huge boulders and large and small pebbles by washing and eroding the flanks of the Aravallis. This can be best witnessed at Nathdwara and on the way to Kankroli. Even the name Kankroli is significant. It means full of stones. These heavy rains and other weathering agencies must have acted on all the old rocks of the Aravallis such as granite,gneissic, quartzite and shale,but since the quartzite is the most resistant, mostly boulders and pebbles of this rock have survived all these lakhs of years. Other rocks including the softer sandstones, were gradually reduced to sands. The sands also filled up the river bed. Then for some reason, the climate changed and the rivers were not able to bring large pebbles, nor carry forward the older material. So mething like what is happening today-what we see today at Nathdwara for instance-had happened at that time. The river beds of lime were filled with masses of pebbles and sand.

It was in this environment–these surroundings-that the first Man appeared. Intentionally I do not say that the first man was born, because this would mean that Udaipur was one of the first regions in India or the world where man first took birth or evolved from earlier stages of evolution.

This man saw the quartzite boulders and pebbles around him, as well as pebbles of other rocks. But either from natural instinct, or previous experience, he preferred to make his livelihood with the quartzite pebbles rather than softer rocks like shale or sandstone, or intractable stones like granite or gneiss. What did this man do with these quartzite pebbles ?

For breaking or crushing, a naturally rounded or oval pebble would be most useful. And that the Man did and would, exactly as after lakhs of years we still do in India, and many parts of the world, where modern civilization has not completely replaced the pebbles. But for cutting purposes, he had to break the pebbles, and get a sharp-edged edge. The simplest way of breaking a stone or pebble is either to strike one pebble against another, or to strike by throwing one large pebble or boulder against a boulder on the ground. As children, we often did this, particularly when many pebbles are around.

The result of this haphazard cutting is known to all. Large and small splinters of stone would spark off on all sides. A careful look at some of the large flakes would show that they leave broad and convex (a slightly rounded) edge. The side opposite this edge would be thick and suitable for holding the flake in one hand. Such a man made stone flake or chip, however crude and elementary from our point of view, shows a raised round surface, like the rising sun, just at or near the thicker end, meant or suitable for holding. If the quality of the stone is very good, that is, if it is of

homogeneous texture and not coarse, full of large grains of sand, then this raised surface, known technically as bulb of percussion, is very prominent and shows additionally rediating lines, each larger than the preceding and closer to the bulb.

It was such a large flake with fairly sharp broad edge and bulb of percussion on the underside and pebble surface that I picked up at Nathdwara on the Banas in October 1955.

Exactly similar flakes have been found in the Narmada, in the Sabarmati, near at hand on the Shivna at Mandasore. In fact, wherever similar conditions are obtained man has made the first stone tools in this way.

But nowhere man has been content to make such very simple primitive tools. He soon learnt that if the pebble or flake he used was thick, a sharp and more lasting edge can be made by making it from both the sloping surfaces, that is by flaking alternately now one side, and then on the other. Thus a thick round or oval pebble can have a sharp edge. This can be useful for cutting, as well as chopping, that is, felling trees, and bones and flesh of animals.

Because man is man, that is a thinking animal, he was not satisfied with these two kinds of tools, viz. large flakes for cutting and scraping, and thick pebbles with an edge on one side for chopping. Oval pebbles, when flaked from both sides, give a fairly sharp point and edges, such a tool would be very useful for several purposes, for digging, for ripping open the thick hide of the animal, and even for hunting, that is thrusting like a spear from some distance.

Man here around Udaipur, as well as in the rest of India, Europe, Western Asia (Iran, Pakistan, Syria, Turkey) and in the whole of Africa, loved to make these stone tools or weapons from an oval, or roundish flake or pebble, better and better-more and more symmetrical, lighter, flatter, pointed an one end or both ends and sharp on all sides, so much so that we in our ignorance begin to doubt whether such tools known by their shapes as ovates, cordate (heart-shaped) or pipal-leaf like, or triangular, had a function or use or were made for ceremonial purposes.

What is remarkable is the perfect mastery over the material in shaping it in to a beautiful form,that too not with the help of iron or copper tool, but only by stone, wood or bone hammer.

Where in Rajasthan do we find these beautiful stone which are thousands of years old? In small numbers practically in all the rivers Banas, Gambhiri, Wagan and Kadmali, but in large numbers, said to be 'infinite' at Chitor and Nagari.At Chitor, just where we cross the bridge near the Railway station to go to the fort. In an emotional mood, a Rajasthani (Udaipuri) might say Chitor has been the home of warriors rightfrom the stone age !! However, there is no doubt that a fairly large group of men lived on the foothills of Chitor fort, and made stone tools for various purposes exactly as I have described them.

This inspite of the fact that the ground here is very uneven, being made of horizontal sheets of schists and sandstones, which makes driving in a tonga very difficult.

But there must have been some attraction for the Early Man, why he preferred to live around Chitor? The first is the availability of quartzite pebbles, secondly a high safe place, which was fairly wooded, so that in the jungle he could find edible fruits and roots of trees, and animals-such as ox/cow, elephant, rhinoceros, hippopotamus, all of a wild type and distant ancestors of the prssent living ones. Remains of one of these animals has so far been found from the rivers of S. E. Rajasthan, but we know that these animals roamed the adjoining forests of Madhya Pradesh and the distant Maharashtra.

Until the other day, I was afraid of speculating about the vegetation, the kinds of some trees that might have been growing at that time. Some-true knowledge of this can only be had either when we discover the remains of fossil plants in the ancient river deposits,or the pollens grains are extracted from such deposits and studied in a special laboratory-a science called palaeobotany.

Failing both these definite clues one might infer about the past climate and vegetation, from what one finds in the region today, after eliminating all recently planted species of trees, one confines his attention to what the botanist calls primeval forests. One has then to inquire whether the ancestors of the primeval species grew in the early human or prehuman times in the country under study, that is S. E. Rajasthan in our case. Students of this subject-viz. plants, trees, fruits and flowers-botanists and palaeo-botanists (those who specialize in the study of fossil species) tell us that the trees

like the Kharjura, Babal, Pipal, Vada and possibly the mango and the Mahuva are indigenous to India ; further the remains of their ancestors are found in the rocks of prehuman period in India, though for want of adequate search and other reasons, their remains have not so far been found in the deposits between the present and prehuman, called Pleistocene. Therefore, though no direct links can be established between the present and the very, very distant past, still we would be justified in assuming that here S E. Rajasthan grew the Pipal, Vada, Mahuva and Neem, and there were fairly extensive groves of Kharjura trees such as one sees when going to Chitor from Udaipur. Some ten years ago when I first saw these Kharjura groves I thought that these should have been indigenous, growing here naturally. But we usually associate date palms with the very semi-arid countries like Iran, Arabia and Egypt. And to one might say that these date-palms of Chitor were the products of Islami contact with India. This view is said to be fallacious. And I was surprised to learn that no less than eight out of ten species of date palm grow in India, but these do not bear fruit because the environment- climate, water and soil-is not congenial for its good growth.

We can thus reconstruct the picture of Early or First man in Rajasthan-a land of rivers flowing in very wide valleys, atleast double or triple the size or previous ones at some places, over an uneven surface, so that at places there were deep pools of water. The bank of these rivers were not high, hardly 5 feet. In the foothills where there was soil cover

grew the kharjura, pipal, neem and vada, mahua and mango, and the ubiquitious babul and thor. In these primeval forests roamed cow/ox, neelgai, rhino, and hippopotamus and even the elephant and tiger, deer of various kinds. These were occasionally hunted by Early Man, who had come here atleast a lakh of years ago. This hunting as well as gathering of fruits and roots was done by stone tools which were not only primitive, but also symmetrical and beautiful. Other tools and weapons of bone and wood might have also been used, but no trace of these is now left.

This Aravalli Man was in no way (culturally) different from his contemporary in the Sabarmati valley in Gujrat, or the Chambal and Narmada in M.P., the Godavari and the Krishna in Maharashtra, the Tungbhadra in Mysore and the Kaveri and the Kortalayar in Madras, and the river valleys in Andhra, or the Burhabalang and the Mahanadi in Orissa, or the small rivers like Ajaya in Western Bengal, and the Balia Nadi in U.P., and the Sohan in the Punjab. For his tools–choppers, handaxes, cleavers and scrapers, and even the carefully, preplanned made flakes are in no way different from all these regions of India.

Further, not only there is similarity or identity in types of tools, practically all over India, but the river deposits, viz. boulder or pabble beds in which these are formed, again all over India, seem to be contemporary that is laid down at the same time, under identical climatic conditions.

We are thus certain about the Aravalli Man and his cultural affinity with Early Man in the rest of India, and in

other parts of the world (such as Western Europe, Western Asia and Africa), but we are not sure—know next to nothing —who this Early Man was, what was his physical appearance. Was he like the Bhils or the Minas, short about 5 ft. in height, round, with curling hair, with snub nose, thick lips, and comparatively black, or the tall, sharp featured fair, Rajput ? In absence of this knowledge, viz. the physical appearance of Early Man in S.E. Rajasthan and the rest of India, we cannot say whether he had migrated there from the Punjab, in the north, or Malwa and Gujarat in the east and south respectively, or from Africa or whether he was the aboriginal resident of Rajasthan or whether he had used S.E. Rajasthan as a corridor to pass on to these neighbouring regions, having once entered it from the Punjab or Africa.

Probably intensive, well planned work by a trained body of workers around Chitor will bring to light more data about Early Man—his physical remains, as well as cultural and environmental details.

There is no doubt that Early Man had remained in this state for a long time (though I have not taken more than 500 words, or just one paragraph, less than a minute to describe his mental development, as revealed by his stone tools). But this fact is well demonstrated by some sites in Africa, such as Olduvai Gorge, in Tanzania (former Tanganyika). According to our present knowledge, it took some 4 lakh years to make him symmetrical oval or triangular tools from simple pebbles or pebble halves or flakes. This is a very, very slow progress or development is comparable to

our own. After man acquired the knowledge of copper, it took him three to four thousand years to discover iron and great advantage over copper. Steel was produced after another 500 years or so (c. 400 B.C.). Since then we are in the Iron Age and remained so upto the Industrial Revolution (c. 1700 A. D.). Progress was then rapid, and indeed phenomenal after the last world war.

This is enough to understand that Early Man in Rajasthan must have undergone a long period of mental and probably physical development. The former can be demonstrated to some extent, the latter, viz. physical development or changes, cannot be for want of evidence.

About 50,000 years ago a great climatic change came over S.E. Rajasthan and the rest of India. This was also the time when Western Rajasthan had come up from the sea, or the sea had retreated, and the first Luni had began to flow over the newly formed land. Probably this had formed a land connexion with Africa or through Sind with Iran and Western Asia.

There is no direct evidence for this great phenomenon. We have to infer the climatic change from what we witness in the rivers of S.E.Rajasthan, as well as in the rest of India. All the old deposits consisting of pebbles/and boulders were covered under a thick mantle of silt, which has in course of thousand years turned reddish or dark brown, and against it or over it whenever this silt has been eroded lies a comparatively finer gravel, capped by light brown silt. What do these physical or morphological changes signify ? we really do not

know all the causes. Two or three explanations are generally offered. The first is that after the formation of the pebble bed, the rain gradually became less and less, and the river bed was filled with, first heavier material pebbles and boulders, and later fine sand or sandy clay as at Hajiakhri, near the bridge of Chitor.

How long this dry phase lasted cannot be guessed. But then the climate once again changed. The rivers were rejuvenated, that is once again they began to carve out their beds. However, instead of bringing pebbles as before, they only brought only fine gravel, which did not contain quartzite pebbles, but smaller pebbles and nodules of chert, flint and such rock which have a very homogenous texture or composition.

The other explanation is that the river beds were filled up because the sea level rose, owing to the melting of the ice, all over the world. When the rivers could not employ their water into the sea, naturally this damming made the water, and the contents flow back. Thus the river beds were raised, exactly as when we artificially put up an earthen or stone or concrete dam and a lake is created, where there was once only a river, flowing some 10 to 20 feet below the surface.

Such natural dames are also made when a barrier is thrown up across the river by land slides, or uplift of the land, owing to earth movements. Owing to any of these there causes the climate–heavy rain–the rise in the sea level, or

Thus was a slow change brought about in the life of Early Man. Necessity made him devise newer tools. And if the earlier tools restricted his movements because of their size, the smaller ones enabled man to enter deep into unexplored areas, because he could carry his tools with him, if need be. And this is probably the reason why the stone tools of the Second Stone Age are found in different parts of India.

Their discovery of recognition in India is not more than 13 years old, and in Rajasthan hardly 10 years old. These tools were first found in a stratified deposit in 1943, but assigned to an early phase in Stone Age in 1955 at Navasa, District Ahmednagar. Later when Dr. Misra was advised to explore Western Rajasthan, which was hitherto quite blank as far as the Stone Age was concerned, he found fine tools in the Luni Valley. Most instructive were the outcrops of chert and flint near Sojat which I had an opportunity to examine with the late Dr. Subbarao. Misra was thus able to put Western Rajasthan on the Stone Age of India.

But what about S. E. Rajasthan ? Here in a very brief and hurried visit in 1959 we had discovered late in the evening only three tools in the Berach near Dhanet and then for three years no further tools of this nature were found. However, I had expressed the hope that further search in the river valleys would bring to light more traces of this Stone Age.

This was fulfilled when we explored the Wagan from Hajikheri upto its confluence with the Berach. Later Misra

no carrying bagsnets baskets, or any other containers.

Thus, it was most unpracticable and uneconomical to continue to use the earlier material, even if it were available, at some places. On the contrary, the adaptation to the new resources, initially, probably, out of necessity, brought about some change in the life of the man. He was still a hunter and gatherer of wild fruits and roots of trees.

The small pointed tools could be hafted into a split bamboo or twig of a tree, and tied with a gut (thin, string like chord from animals stomach) or a creeper and cemented with gum. Thus was created the first long distance weapon (the ICBM of Early Man ?). No doubt, earlier we had fine pointed handaxes but there were probably used as spear or lance heads.

Another variety of the pointed tools has a very small point, very often on the broad side. These would be most useful for boring a hole in skins, and thus pave the way for stiched skin and bark clothing.

That animal skins or barks were in great use at this period of man's life is also suggested by the large number of flat or flattish stone flakes or nodules, with a straight convex (hollow), or a concave (rounded) edge. These are obviously scrapers. needed for scrapping barks, skins and smoothing thin and thick twigs of trees for preparing sticks and handles. These sharp-edged flakes, particularly with a thick back from the Luni valley, could also serve as efficient one-edged knives

tonga, and the tonga in its turn displacing the cart. Instances can be multiplied. The fight for survival by man, animals and vegetation is as old as the earth. Those who adopt to the new conditions survive. The same thing happened to the man in Rajasthan, and all over India. When the large quartzite pebbles or basalt dykes were no longer easily available, he searched for newer material. Where could he search ? Naturally around him, in the river valleys and foothills. By trial and error the man found the chunks, and nodules and small pebbels of agate, chert, flint and such fine grained stones which are formed in the basalt hills or limestone and sandstone rocks. The size of these chunks and nodules is rarely bigger than five to seven inches in length and three to four inches in breadth, though large blocks striking out from the earth also occur. Normally this Second Man preferred to make pointed and sharp edged tools/weapons out of the chunks and nodules, because they were easy to handle, and very often their natural shape itself dictated or suggested the final form of the tool. However, there are instances where the man has broken large blocks and made smaller tools out of them.

We thus see that man was largely dependent upon nature or his environment. He could not make very large tools as his predecessor, even if he wanted to, because the material was not easily available. Could he not import it ? Certainly not. In the first place large pebbles were probably buried under river deposits. Secondly, at the most one can carry three or four pebbles at a time on one's hand, as there were

land uplift the river beds were raised, and earlier deposits were covered by gravel and silt.

It should be noted that all the three causes are also responsible for the rejuvenation of the rivers, that is for *lowering the river beds. When rain increases, the rivers are* able to scour their beds both vertically and laterally. This can also happen when the rivers which were formerly dammed by the incoming sea, begin to flow into the sea, begin when the latter's level goes down considerably. Similar effect is produced when the land is uplifted, particularly near the upper reaches of the river. In all the three cases, the gradient of the river bed becomes steeper, or the river flows at a steeper gradient.

Often there is not one cause. It will require the efforts of a joint team or geologist, geomorphologist, hydrologist, climatologist and an archaeologist to determine the exact role of these and other unknown factors.

Suffice here, for our purpose, to observe that the earlier river deposits were hidden by newer deposits which were considerably different in colour and texture. This had a profound effect upon the life of the Early Man. Gradually he began to lose the source of his raw material, namely the quartzite pebbles.

This fight for survival, takes various forms. At the moment we are resisting the computors, for these make a large number of clerks, and other staff superfluous. A few years ago it was the cycle–rickshaw or the scooter against

discovered more sites in this river as well as in the Kadmali. Upto date some important sites are known. But it is curious why no tools are found in the Banas, Berach, and the Gambhiri the major rivers of this region. Is it due to want of the raw material, or because these rivers were not accessible to Man ?

Any way the desert of the tools of Second Stone Age in S.E.Rajasthan as well as in North Gujrat which are not only contiguous, but are the northern and southern flanks of the Aravallis, raises important questions about the origin and spread of this culture, particularly in view of the fact that the traces of this culture are widespread in W. Rajasthan. Are we to construe from this feature that the Stone Age man having flourished in this comparatively new land, crossed the Aravallis and entered S.E. Rajasthan, or that the old man, man of the First Stone Age not finding suitable raw meterial iin S.E.Rajasthan, migrated to W.Rajasthan, where stone of compact fine texture was easily available in the form of flint and chert nodules in the limestone formations ? Or is there a third possibility viz. that another man having specialized in this kind of tools outside India, in the caves of Iran, Iraq, and Palestine and further afield in Western Europe had slowly turned his steps to India, and finding a land bridge, in Sind and Western Rajasthan, entered India.

I saw no possibility of this new external influence until last year. But when I was studying the question afresh, and found many types of tools in our Indian collection and particularly in Misra's collection from the Luni Valley which were comparable to those found in the countries mentioned

above, I seriously began to entertain the view that very probably our Secend Stone Age was in some way influenced by cultural developments in Western Asia.

And in this cultural exchange, Western Rajasthan, as throughout its history and even its early phase called protohistory, would play an important part, as the first receiver and the transmitter of peoples or cultures.

What are the tools in Misra's collection which have suddenly become so much important ?

As I told you above there are the usual points, borers and scrapers and some knife-like blades. But what struck Misra and I among this four main types of tools was the way in which some flakes for preparing the scrapers were made and the way some flakes, thick as well as thin were turned into scrapers and points.

There are three ways or methods by which a pebble or a block of stone can be broken (flanked) First by striking one stone against another. This does not require much thought or planning. Children invariably do it, and the elders too when they are in a hurry or angry. But this was not all.

Some of Misra's points have been carefully worked from both surfaces, hence we call them bifacial. Then there are very small miniature handaxes and cleavers.

All these remind us of a slow transition from the Early Stone Age to the Second Stone Age. Now this feature is well

illustrated and even dated in North Africa, Western Asia and Europe. In Europe and Western Asia, such carefully made scrapers points and flakes have been attributed to a type of man whose remains were first found in a cave at La-Moustier in France, and hence called Mousterian. This man is known as Neanderthal Man because his physical remains (fossilized bones) were first found more than a hundred years ago at a place called Neanderthal in Germany.

There was a time when this Neanderthal Man was believed to be so different from the present species of man (**Homo Sapiens**) that he was assigned to the extinct species. From a study of his bones and teeth he was pictured as brutish and primitive with low forehead, and massive heavy eyebrows and facial contours. Such a view is no longer held. On the contrary the general belief is that he was so similar to modern man (**Homo Sapien**) that the two could interbreed and produce fertile offspring. Hence the maker of this intelligent, fine type of tools is classsified as **Homo Sapien neanderthalensis** a Sub-species of **Homo Sapien.** What is most interesting from human history is that this man whatever be his true ancestory and physical appearance, was quite human. Not only he loved flowers, but he buried the dead in a grave deep inside a huge cave. And the dead body was kept on a bed of pine boughs wreathed in a multitude or spring wild flowers. This was 60,000 years ago, in the Shauidar cave, 420 Km. north of Baghdad in Iraq.[1]

1. Science Today, November 1968, p. 43.

The reason for relatives the latest development in the Neanderthal Man is twofold. First, that any day, remains of this man might be found in Rajasthan in India, where as I told you we have the stem tools, in many respects similar to the tools made by Neanderthal Man in Europe and Western Asia. Secondly, this extraordinary insight into the life of the man was obtained by the collection and study of pollen grains, preserved in the soil from the cave !!

Likewise, a study of the bones of one of the buried man. In the cave, showed that he suffered some physical defect while alive, still his fairly members did not reject him as useless, but continued to feed him and look after him, as we would do. Thus this Man so far thought to be a brute, was humane too.

But there is another method. Here we prepare the pebble (or core) from which the flake is to be removed by carefully removing flakes around the periphery of the pebble, and then give a blow at a definite point on the periphery. When such thought is given, or the whole process is planned, a thin symmetrical flake comes out from the pebble or the block of a stone. Such a method of removing a flake or technique is called prepared core technique. Very often it is called Levallois technique after the place in France, viz. Levallois Perret near Paris where flakes of this nature as also the cores from which such flakes were detached were first found.

What is remarkable is that in the Luni Valley, both the flake and the core from which the flake was taken out have been found.

Of course, since Misra's discovery in 1959, other regions in India, have also yielded such prepared flakes and cores.

Now when the tools were first recognized at Nevasa in 1954–55, or when Misra discovered still better tools as described above in the Luni Valley, we could not think of connecting these tools/industries with those in Europe and Western Asia, because vast, intermediate spaces, now known as Pakistan, Afghanistan, and Soviet Central Asia, had not yielded traces of Mousterian culture. The story is now different after 10 years work. All these blank spaces in the map have began to be filled up. Hence I have taken the liberty/courage to relate/derive our Second Stone Age, known in our language as Middle Stone Age or Middle Palaeolithic man from Europe through Western Asia.

In tracing this relationship between India and Western Asia/Europe and North Africa, Rajasthan's crucial role cannot be lost sight of. On the one hand it is connected with the Punjab, on the other with Sind. The punjab has already yielded well stratified traces of small, miniature handaxes as well as cleavers at Chak Sighu and Morgan near Rawalpindi (I have myself seen and handled these in Cambridge, and in Pennsylvania), as well as evidence of Levallois culture. These can be Placed in the geological division of the earth's history known as upper Pleistocene and that too in its later Phases.

Further, on the strength of the data from the Sanghau

Cave near Peshawar, excavated by Dr. Dani, we can extend the Chain through Afghanistan and thence to Iran and Soviet Central Asia.

From Sind there is very little stratified data, still we could think of the industry described by Paterson from Sukkur and Rohri. Here we have large core, flakes and blades. In the absence of details of the Sukkur tools types no further comparisons and conclusions can be drawn.

Within India, the Second Stone Age in Rajasthan can be well compared typologically and stratigraphically with that from all the regions known upto date. Gujrat, including Kutch, Saurashtra, M. P. , Southern U. P. , West Bengal, Andhra, Madras, Mysore and Punjab. Further on the evidence from Maharashtra, we can date it to 30,000–35,000 B. P. , a date which is very near the Mousterian culture in Europe and Western Asia.

Enough has been said to emphasize the importance of Western Rajasthan in understanding the cultural development of Man in India in the dim past. Much more can be learnt, as I shall have occasion to say later, by further, more intensive research.

For the moment, we have to be satisfied with the knowledge that from about 40,000 years ago, Man's life as can be judged from his stone tools was not much different in the Eastern and Western Rajasthan, though the ruw material used was different. It was flint and chert in Western

Rajasthan and chert, Jasper, quartzite, etc. in the Eastern. The environment was different in the sense that around Udaipur in S. E. Rajasthan, the Man was hemmed in by hills, though the river beds were not so broad as before and their banks were comparatively high. The flora (vegetation) and fauna (animals) were not markedly different from those in the preceding period.

Western Rajasthan must have looked much different from what is now. The first river Luni and its tributaries not only flowed in a wide bed, but carried water, probably perennially. The river was always there, and did not arrive only once in a year, if at all, as today, Famines were probably unknown. With more regular rain, and constant river supply, the country must have been considerably greener. In any case the river banks were not filled up with masses of sand, and the few, solitary hillock, around Sojat (in Dist. Pali) stood out clearly as they do now. With such favourable environment water, vegetation, game and raw material–areas like Sojat, became the camp sites of the First Man in W. Rajasthan, and Second in Rajasthan.

How long did this "Eden" (heavenly garden) remain ? Perhaps for a long time, at least for 25,000 to 30,000 years, *until the biotope was disturbed by man and nature.*

Archaeological evidence for Knowing the next stage of Man's life in Rajasthan is so far meagre because little Planned work has been done. Whatever data is there, is of a very

disparate nature. For instance in Northern Rajasthan, we are suddenly face to face with a full fledged city civilization in the Sarasvati Valley and the same is the case in South Rajasthan where truly Copper Age town and villages grew up at Ahar, and elsewhere in the Banas Valley.

But what were the earlier stages behind this development? It is too sudden; what we behold at Ahar and Kalibangan; and the unreported Gilund, can only be described as colonization or a readymade culture suddenly imposed in all these regions.

Elsewhere, in other parts of the world, as well in India, even in neighbouring N. Gujrat, we find traces of another Stone Age. The main feature of this third Stone Age are that man's tools, though they continue to be of Stone, they have become so small and tiny, that we call them microliths, meaning small, tiny tools of Stone.

Though small, these tools mark, as I will explain presently, an important stage in man's cultural (Industrial or technological) development.

What is important to remember is that these microliths have almost everywhere in the world developed out of the earlier industrial complement, and that this was necessitated by a change in environment, particularly climate, vegetation and dying out of most of the earlier fauna.

Whether all such marked changes came over many parts of India, we are unable to say at present. But in the regions

We are most concerned with viz. Rajasthan and broadly Western India and Northern India, the Punjab, Western M. P., Gujrat, particularly Northern, and Kutch and Saurashtra a drier phase of climate had replaced the earlier during which W. Rajasthan, and all the neighbouring countries had seen a more favourable climate, particularly regular rainfall. This dry climatic phase seems to have synchronized with the onset of dust storms in the Punjab, dated *to the last interglacial* period (*about* 10–15,000 *years ago*). These dust storms blew up sand and silt from the Rann of Kutch, and the river valleys and even distant deserts according to one authority, and covered the plains and hill slopes in N. W. Rajasthan. as far as the Aravallis, all over N. Gujrat from Taranga Hill upto Baroda in south.

The river beds were also filled up with sand and silt. Because the rainfall becoming infrequent the rivers could carry their bed load only upto a small distance after a heavy shower. The land was dotted with small sandy hillocks, called sanddunes, with their orientation from S. W. to N. E., and ponds of water, which retain water for about 8 months in a year in N. Gujrat, and much less in Western Rajasthan. These sanddunes have a process to form and reform every year, unless they are fossilized, that is made firm and fixed by vegetation. Such a study of fossil sanddunes will be interesting. For it will throw light on the various climatic phases during the last few thousand years.

In Northern Gujrat our prolonged explorations and excavations at Langhnaj, 60 miles north of Ahmedabad showed

that this region had witnessed first a very dry phase when hundreds of feet of sandy silt was deposited over it. Then about 5,000 years ago, a slightly better climate set in with increase of rain a number of lakes were formed between the hollows formed by the previously made hillocks. On these came to live a man who made microliths, and hunted among other animals rhinoceros. This animal, as we know now survives in the swamps of Assam and Africa, but was once found in U. P. as well.

Now the conditions in W. Rajasthan are not very much different. Here we could expect to find a cultural stage as old as, or older than N. Gujrat, provided we find microliths.

Until 1958, none had been found, then they were found in 1959-60 by Dr. Misra in good numbers near Sojat in Dist. Pali. At about the same time, these microliths had been picked up from the flanks of hills in S. E. Rajasthan. The question was, how old are these Rajasthan Microliths ? Were they old as in N. Gujrat, or still older or younger !! Exactly the type of questions we had asked as far back as 1941.

The only way of answering these questions was to carry out a few excavations in the Estern and Western Rajasthan. Fortunately these excavations have been undertaken within the last two years. These have given some idea of the type of microliths and their likely age.

For affording this knowledge we are once again beholden to Dr. Misra, whose work during the last 10 years

has put Rajasthan on the Stone Age map of India and the world. For before 1958, Rajasthan was *terra incognita.*

During his further exploration in 1966-67, Dr. Misra discovered a few microliths at Tilwara, and at Bagor. Tilwara is situated on the left bank of the Luni river, about 16 Km. southwest of Balotra. The site lies on a low sand dune about 2 km. southwest of the village in the old bed of Luni river.[1]

Bagor is located on the left bank of Kothari river, about 25 km. to the west of Bhilwara. The actual site is on a sand dune, overlooking the river, about 1 km. to the east of the village.

Thus these two sites represent Western and Eastern Rajasthan respectively. It is interesting to note that both the sites are located on a sand dune. If it is really so, and if the sand-contents of both the dunes are identical, and if the orientation of both the dunes are similar, then we might roughly assign their formation to the same period and the same climatic causes.

For culturally these dunes not only do not to be much different, but also appear to belong to the same period. And this, I will comment below, is gcing to be extremely important and complicated for unrevalling the late prehistory and Early history of Rajasthan.

At both Tilwara and Bagor, the occupation seems to

1. Indian Archaeology--A Review, 1967--68, p. 39.

have been confined to the upper half of the mound. At the former site it is almost on the surface for the deposits do not go deeper than 90 cm., But are concentrated in the top 50 cm.

At Bagor, the total depth of habitation debris is 1.60 m. thick. The thin deposits at Tilwara exhibited five distinct living floors and from the arrangement of stones found in Tr. IV–V at a depth of 14 cm. from the surface, it appears that these are the remains of a circular hut, with a diameter of3m. and having mud plastered walls and thatched roofs. These simple huts were provided with flat–topped stones querns and a muller (sila batta) and earthen pots and pans, such as handis, and fire pits containing ash, bones (some charred) and bits of pottery and microliths

The pottery includes two wares: grey and red, and is wheelmade. The grey ware comprises handis of various sizes and seems to have been used primarily for cooking purposes as the outer bottom of these handis is charred. The red ware which has a pale red slip was represented by thalis and lotas. Curious as it would appear, the inhabitants of these circular mud huts with a stone plinth and floor, used microliths, all made from the local material such as quartz, quartzite, chert and rhyolite. The microlithic industry consists of backed blades, obliquely blunted blades, lunates,triangles, points and a few trapezes.

These tools, though so tiny, show remarkable perfection in form and workmanship, compared to similar Industry from Gujrat, or other sites in India.

To complicate the problem further, bits of iron, and fragments of glass and a sheel bangle were found in the upper 10 cm. of the deposit, while beads of bone and carnelian occurred within the first 30 cm. from the surface.

Pottery is more abundant in the top 25 cm. while microliths are more profuse below this depth. So two phases of the culture can be recognized: an earlier one with the rare use of pottery and a later one with abundant pottery.

On this evidence, it is difficult to assign the Tilwara culture to a truly Stone Age period, though one of its constituents Is the microlithis industry.

For even if we disregard the presence of iron and glass bangles as belonging to a much later people, who might have camped temporarily on these early mounds, the presence of wheelmade pottery, such as **handis, lotas** and **thalis,** stone querns and mullers, in regular, though temporary, types of houses, precludes us from regarding the inhabitants as nomads, or pure hunters.

The same is true of the Bagor culture. Here though so far no plans of the houses can be made out because of the limited nature of the excavations, still no less than eight successive floors of undressed stones and pabbles were found. These were of local origin, quartz, schist and gneiss, often

packed for making a compact floor. Later the floor was made of brickbats.

From the evidence of floor level and their constituents the associated pottery, and the presence of iron in the top deposits, Dr. Misra divides the occupation into two phases, an early microlithic phase without pottery and a later phase with pottery. In the second phase again there are two sub phases: an earlier one with hand-made pottery and stone paved floors and a later one with wheel-made pottery, iron and brick-made floors.

However, the microlithic industry comprising blunted back blades, obliquely blunted blades, lunates, triangles, trapezes and points remained uniform throughout. Now all this evidence, suggesting a permanent or semi-permanent habitation is inconsistent with the nature of food habits implied by the large masses of bones, (some of which broken for removing the narrow, and also charred) of animals which are said to be wild and consist of bovines (cow/ox) the hog deer, the spotted deer, the barasingha, the wild boar, jackal, rat, river turtle and the monitor lizard.

The problem raised by Tilwara and Bagor does not end here. The question is, where shall we place it chronologically and after doing so how shall we relate it to the known archaeological history of Rajasthan ?

The proper place for the Tilwara and Bagor microlithic cultures would be sometime after the Second Stone Age,

between 10,000 B. C.– 3,000 B. C. But the association of iron, glass bangles, brickmade floors and wheelmade pottery definitely rules out such high dating. Dr. Misra tentatively would Bagor between 1,000 B. C. and 1st–2nd century A.D. and Tilwara between 500 B.C. and 1st and 2nd century A.D. But even then it does not suit the known development of the cultural history of man in Rajasthan and elsewhere in India. For already by 2,000 B. C. South–Eastern Rajasthan had entered the Copper Age, and discarded the use of microliths. The same story is witnessed in Northern Rajasthan though here lithic blades were still used along with copper/bronze in a city civilization.

But at Bagor we have a true microlithic industry. If therefore the Bagor culture is really late, it would imply either that a lower grade culture continued to suivive or came into existence after the advanced Copper Age culture in the Banas Valley, or that there was a cultural regression in the Banas Valley.

At present we do not know the cultural history of the Banas Valley very well after the disappearance of the Ahad culture in about 1,200 B. C At Ahar itself, iron first came into use in the 3rd century B. C. And at this time there is no trace of microliths in any form.

So we might interpret the Bagor evidence as implying the existence of a low grade culture, exactly as today, when

the Bhils and other aboriginal tribes of Rajasthan continue to live in detached mud huts at a little distance from Udaipur.

Though the Bhils do not use microliths today, and perhaps gave up their use a thousand or more years ago, it is probable that they had continued to use microliths some 3,000 years ago, even when iron was known. It is in some such way that we can interpret the present evidence from Bagor. In such an interpretation skeletal evidence will be of immense help. So far only one human skeleton buried in an extended position probably within the house has been found.

However, there is some hope, that the Bagor culture might antidate the Ahar culture that is go back to a period before 2,000 B. C. For in our excavations, as well as in earlier excavations of Shri Agarwal, a few cores of microliths were found. These should belong naturally to people to earlier people, or to the people who lived in the vicinity of Ahar, and were still in a cultural stage when hunting was still the main source of food, but in addition naturally-growing cereals resembling wheat, Jawar etc. might have been eaten.

For assuming the existence of such wild varieties of the present day cereals we have no evidence, by some planned efforts, this might be collected.

Assuming that these or similar edible grasses were there in S. E. and W. Rajasthan, how did man eke out his living,

when he had no large stone tools, as in the preceding period or iron and copper sickles and arrow heads for reaping the harvests and hunting ? How far microliths are really useful ?

No one can use these tiny stone bits, less than half-an inch in size in the naked hand. Most of them cannot be even handled, much less used for cutting or piercing a hole in animal's skin.

No, Everyone of these microliths, by whatever we might call them and further describe as-blade, lunete, point-were hafted in a wooden, bone or even clay handle. And not one, as we do today, or have been doing for the last 4,000 years. But a series of small blade points were inserted in a handle. Thus came into existence the prototypes-the earliest ancestors of our present day sickles, pen-knives, and harpoons, the three principal implements/weapons for cutting, slicing and hunting.

We might recall that the sickles are called **Dantarda** in Gujrati and possibly in Rajasthani as well. This word means "a tool with teeth' (dant) and thus reminds us of the first stone-tipped toothed sickle of the Stone Age.

Such stone-tipped sickles of bone and clay have been found in Egypt, Palestine, Turkey and Yugoslavia, sometimes in **silos**, that is **Kothara** or large earthen pots or baskets (Egypt) for storing wheat.

Further, experiments in recent times have shown tha such stone tipped sickles were quite efficient. A field o harvest could be reaped in ten hours.

Perhaps you must have understood now why the man using microliths was placed on the higher rung of the ladder in this march of civilization. For conceiving and making possible the use of compound tool. All the earlier tools/ weapons consisted of a single object which was to be held in the naked hand, and used for various purposes.

With the invention of the compound tool/weapon, the man had made a revolutionary discovery. This principle is not only is the basis of our tools and weapons, such as bow/arrow, spear/dagger, sword, knives, big and small particularly small, harpoons and sickles, but guns and rockets (which are made of several parts) and depend upon further discovery of the gunpowder)..

Hence the first microlith makers, are regarded as our Early Ancestors, for they put us on the way to civilization, by the discovery of the principle of compound tools.

But is was not sufficient to discover this principle. The tools had to be accordingly made, so fashioned, that they could be easily inserted in a wood, bone or clay handle without damaging the hand or the haft (handle itself) by the sharp edge of the tool. This was cleverly achieved. while the working side of the blade/lunate is sharp, the other side is beautifully, almost invisibly, made blunt. Almost every tool, has one of its side so blunted by what we call "steep retouch". In the case of the lunate, which is the most

recognisable tool, this retouch is on the curved side (arch) ; in the case of the trapzes and triangle on two of these sides and in the case of the backed blade, as the name connotes, on the thicker side of the side.

The name which I have given for this tools are purely descriptive of their forms and shape. We do not know how the man called them in the dim past. The accompanying illustration will explain the use of these tools.

One word about the technique as what these were made. The first thing is to produce a thin flake, whicn is called blade, because it resembles our modren blade.

The Birth of Civilization in Rajasthan

Through the man's tools over the centuries and millennia we sketched the development in man's way of life in S. E. and W. Rajasthan and reached the stage when he had discovered the use of compound tools with which such activities as hunting with the bow and arrow, fishing with the barbed harpoon, and reaping naturally growing cereals such as wheat, could be done with stonetoothed sickles. Thus man was not entirely dependent on hunting, nor on the collection of fruits and roots. A more permanent way of sustaining himself was beginning to be achived. With an assured food supply was felt the need of storing, and the consequent need of protecting the stored food. Thus were born the first habitations. The need of housing was felt both in the Western Rajasthan which was becoming semi-arid and desert-like as well as in S. E. Rajasthan.

Earliest Houses

Though not yet well dated, and placed in the chronological framework of man's development in Rajasthan Misra's excavations at Tilwara, District Barmer, now in grip of a severe famine, and Bagor in District Bhilwara, would fit in the development visualized above. For at both the sites he

has unearthed remains of circular one room huts with a flooring made with rubble stones. The walls were presumably of clay in mud, plastered on split bamboo screen, supported by undressed wooden posts. The pottety is surprizingly wheelmade. That is a regular pot with his simple equipment a wooden clay wheel, pit for storing or preparing the clay and a stone dabber, and a wooden clay wheel for giving the finishing touch-was a regular member of these camp-dwellers, who for their daily life were dependent on tiny stone chips, called microliths. Though there is some difference between the Tilwara and Bagor pottery, there is none as far as the main microlithic types of tools are concerned. Understably the rock stone used varies.

As the distribution list prepared by Misra shows, probably there were such transient camps of microlith-makers in the Banas and Luni Valleys.

Who these people were we do not know ? Upto date only one skeleton (human) has been found at Bagor, and in future many more might be found. It would be interesting to know the physical type of these men particularly their relation or affinity to the *aboriginal population formed by* the Bhils, Minas and others in this region. At the moment, it can only be said that the Bagor people buried the dead in the houses. The practice of burying the dead in or near the habitation was very wide spread in the ancient world. In India, so far, it has not been witnessed in the Indus Civilization, but has been documented by numerous graves

from Baluchistan and Andhra, Mysore, Madras, Maharashtra and at Langhnaj in North Gujrat.

However, these experiments at Bagor and Tilwara were not the harbingers of a full-fledged civilization. Man did not yet live in permanent houses, and produce a variety of pots and pans, domesticate the animals such as the cow/bull, goat/pig, and above all cultivate cereals and know reading and writing. These are regarded as the hallmark, the minimum achievements which would entitle a community of pepole to be called civilized. I must explain a little, if I am not be misunderstood, by "our" people For what I have given here as the basic requirements of a civilized people, as true of or holds good in the anthropological sense. It is a materialistic definition of civilization, which does not take note of the spiritual heights attained by man.

But at the moment, we are dealing with archaeology which is primarily a record of the material attainments of man.

So to continue our story. The first traces of a civilized life we witness in the present district of Ganganagar, the former Bikaner State. This is the region of the Vedic Sarasvati and Drishadvati. Here as the Rigveda our age-old tradition tells us lived the Rishis who composed the hymns in praise of Indra, Agni, Rudra, Savita and Visnu, and the goddesses Prithvi and Usha. This is our earliest literary, historical and religious record.

The Sarasvati

Curious as it might seen, it is in this region, on the banks of the Ghaggar which is no other than the Vedic Sarasvati that the spade has uncovered the remains of a city civilization, which is earlier than the Indus or the Harappan. Naturally, the scholars all over the world, and particularly in India, are anxious to know the nature of this civilization. Particularly, who could be its authors ? And this curiosity is sharpened or heightened when the archaeologist tells us that unlike the Indus Civilization, the pottery of the pre-Indus Civilization has much in common with the Baluchi and Iranian pottery. And one is immediately reminded of the close realationship between the Rigveda and the Avesta.

But and this proviso is important at the moment we cannot equate either the Vedic or the Iranian Culture with the pre-Indus or the Indus or still much later Painted Grey Ware Culture of which abundant traces have been found in the Sarasvati Valley as well as the Ganga-Yamuna Doab. And since this series of lectures are based primarily upon the archaeolcgical evidence, I would not like to dilate any further on the correlation of the literary data with the archaeological data. Suffice if we are apprised of the possible correlation in future, in view of the rich literature that we possess.

That some two hundred years before the Indus or the Harappa Civilization the Sarasvati Valley could have been inhabited by civilized man, living in towns and villages buil

with mud-brick houses and fortication, and having a wide variety of pots and pans, all turned on the wheel, was hardly suspected some five years ago. To be sure, a hint was given, first by Harappa, then Kot-Diji and Amri in Sind, but little did any one in India hope for the extension or the existence of this pre-Indus Culture in Rajasthan, though looking to the closeness of the two regions this was but expected. However, we are all hide bound by assumptions and prejudices. And it is difficult to forecast.

The pre-Indus Culture has so far been exposed stratigraphically only Kalibangan. But a student of the Deccan College, Mrs. Katy Dalal (nea Frenchman) has located several mounds in the Sarasvati-Drishadvati valley, right up to the Pakistan Border.

Kalibangan

Kalibangan is situated on the left bank of the Ghaggar. The modern village lies at a distance of some 4 furlongs (3/4 Km.) from the ancient site.

The latter consists of two mounds, an eastern and a western mound. These form a prominent feature of the landscape with their slopes strewn with darkbrown nodules, mudbricks, and numerous potsherds. No traveller in this desert, whether he be an archaeologist or not count but be struck by this feature, for these are so conspicuous among the masses of sand dunes on the west, east and south and the green fields on the north, the latter as a result of irrigation.

Whether right from the beginnings there were two separate but closely knit habitations which later turned into mounds on their desertion or whether the Harappans who in our present knowledge initiated this feature in their town-planning and civic life cannot be asserted without large scale excavation on both the mounds. For the pre-Indus Harappan settlement is exposed in its barest outlines only on mound I, known as Kalibangan (KLB-1). That is, the earliest and in our knowledge the first habitation took place very near, or just overlooking the river, the present dry bed of the Ghaggar. The river is now silted up, and there is hardly a bank worth the name. But anciently the river might and should have flowed at least 15 to 20 ft. below the present surface. On such an elevated surface the first inhabitants of the Ghaggar settled.

In several ways, these first settlers are remarkaelb and distinct from their successors, the Harappans.

The houses were made uniformly of mud-bricks, their size being 30 cm. X 20 cm. X 10 cm, that means the length was thrice the thickness, while the breadth was just double. These bricks were laid very efficiently, to provide the requisite strength to the structure. A course of haders was followed by stretchers. Such a method, called "the English bound" of brick-laying in masonry was followed by the pre-Harappans. Further, they anticipated the Harappans by occasionally using specially made wedge-shaped bricks to get over awkward corners in houses (and plinths of (walls)?.

Since these pre–Harappan settlement lies immediately underneath the Harappan, it has not been yet possible to lay here a complete house, so that I cannot tell you about the plan of any house, and the size of rooms, and such other significant details. However, something about their hearths or **chulahs** is known, and this to me is important. For these are true ovens, whether they be underground or overground variety.[1] These ovens are said to resemble very closely the present day **tandoors**, which again, we are told, are common in the Bikaner region. This is a very important feature. For people in India do not generally bake their bread by keeping it against the walls of an oven, we first bake it on a **tava** and then put it on an open fire, so that the bread would swell or liven up. But the **tandoori** fashion of baking bread is current all over Western Asia including Iran, Iraq, Turkey and has penetrated the Balkans, or parts of Yugoslavia. Thus this one feature helps in tying up W. Rajasthan with Iran and Western Asia, and that too as early as 2,500 B. C.

This pre-Harappan settlement was protected by a mud-brick fortification. When first built it was about 6 ft. (1.90 m.) wide, but later the width of the wall almost doubled. It varies between 3.70 and 4.10 m. The necessity of such an increase indicates that the inhabitate felt insecure with a wall that was only 6 ft. wide Hence made it nearly 12 ft. This is certainly a good thickness for a fortification

1. Lal. B. B. and B. K. Thapar, "Excavations at Kalibangan"; Cultural Forum, July 1967, P. 80

wall at this period, for it had to withstand only such missiles as stone or copper-tipped arrows and clay or stone sling balls. Whether this wall could be easily scaled or not cannot be said, for their is no means of knowing its height. Since the later arrivals–the Harappans in our present knowledge–had to break it or remake it to suit their requirements.

What is important is that the traces of a fortification wall has survived, or, if you remember, we were tcld by Marshall some 40 years ago that the Harappans lived in open, unwalled cities, and therefore they were a non-violent people. Then came Sir Mortimer Wheeler who was the first to identify a defence wall at Harappa and then later at Mohenjodaro. This discovery made him propound his famous theory that the Aryans destroyed the Indus Civilization, for he saw in India, the Purandara, one who destroyed "walled" "fortified cities".

Now with the discovery of fortification at Kalibangan and also at Kot-Diji in Sind, where the mudbrick wall has a plinth of stone rubble, the whole problem of fortification takes a different turn.

The least we can say that the Harappans were not the first to have fortified cities in Sind and Rajasthan. And hence the question of Aryans alone being "the Purandaras" does not arise. These might as well be the Harappans.

Again, they were not the first to introduce wheeled

conveyance and metal tools/weapons, in these regions, for these were also known to the pre-Harappans.

But what the latter did not have was, the first access to the flint quarries of Sukkur and Rohri, so that their tools for daily use in the house—for cutting, slicing and piercing-had to be made from (presumably local) material snch as agate, chalcedony and carnelian. These tools are in no way different from the microliths made by the Bagor and Tilwara people, except that at Kalibangan we have mostly straight-sided blades and fewer lunates, trapezes and such geometric shapes. This small difference is significant, indicating that man no longer needed and made compound tools like the sickle and harpoon and the arrow-head with stone tips, but utilized (probably) Copper tools instead.

However, the most striking difference between the pre-Harappan and the Harappans, which is of utmost importance to an archaeologist, is pottery. The Harappan pottery is bright or dark red and uniformly sturdy, and so well baked that no part of the core remains yellowish or blackish, showing imperfect firing. This is not the case with the pre-Harappan pottery, The latter is pinkish, comparatively thinner, and not so well baked as the former. Some of it is distinctly carelessly made. One of its variety, though well-potted, has its outer surface, particulary the lower part, roughened or rusticated (This is also seen at Ahad). Still another variety, represented mainly by basins is decorated all over by obtusely incised patterns on the inside and with single

or multiple rows of cord–impressions on the outside.

Not only the fabric and most of the decorative patterns, but the forms of the pre-Harappan pottery are strikingly different from the Harappan. While the graceful painted Harappan vase, the goblet and the cylindrical perforated vessel, and the variety of footed dishes or fruit-stands are conspicuous by their absence, present are some six to eight types of small and medium-sized vessels. And amongst these, the most noteworthy is a small footed-cup. This and its like remind us on the one hand of the earlier Iranian goblet from Sialk, and Hissar and on the other the goblets or footed cups from Navdatoli on the Narmada, opposite Maheshwar.

So for we do not have much information about the pre-Harappan Culture at Kalibangan, because as I said above it underlies the Harappan, and unless the latter is removed, the former cannot be said here, or exposed. But surveys by the Deccan College coupled with earlier work by the Archaeological Survey of India leaves little doubt that this pre-Harappan Culture was widespread in the Sarasvati-Drishadvati Valley or the former Bikaner State. And this is not all. When we think of this culture in its larger context, its occurrence in Sind, at Amri and Kot Diji, and probably in the far off Harappa, near Lahore, in the Punjab, there rises before us a cultura which, if not so extensive as the Harappan, was fairly extensive, encompass as it did, the

Punjab, Sind, and N. Rajasthan. And the question arises? Was this culture indigenous? Did it grow up on the Indian soil? or was it transplanted from outside? from Iran and Western Asia? At the moment we cannot say anything definitely. For want of organized and planned work we do not know anything about its antecedents either in India or Pakistan, while, as shown above, we do discern in its pottery forms, and decorative designs as well as in the form of the ovens, a few Iranian and Baluchi affinities.

Partial Colonization

Thus I would provisionally describe the pre-Harappan Cultural stage in N. Rajasthan, as a partial colonization. For it consists of some foreign elements, and some - such as the chalcedony and agate blades-local elements. The latter might have developed from the earlier Mesolithic stage, not yet documented from Rajasthan, but present around Peshawar. This would mean that the true stable element, indication of a habitation—a farming village—was introduced from outside. And if in future, no further proof is obtained about the earlier stage of pottery making in Sind and Rajasthan, then we shall have to attribute its introduction to the Iranian influence.

The First Full-fledged Civilization

Whatever it be, we now know that the earlier cultures in Sind, the Punjab and Rajasthan, were supplanted by a true city civilization, the beginnings of which we do not know. Hitherto, it is best known from the excavations at

Mohenjodaro, Chanhudaro, Amri, Kot Diji in Sind, Harappa in the W. Punjab, Rupar in E. Punjab, and Lothal, Rojadi in Saurashtra and Desalpur in Kutch. Its appearance in N. Rajasthan is but natural. For this region is immediately to the east of sind, where in the Indus Valley, it is believed to have originated.

Though numerous harappan sites have been spotted in the Sarasvati-Drishadvati valleys, so far only one site is excavated. This is Kalibangan in the present Ganganagar district. Its careful excavation by Shri B. B. Lal and Shri B. K. Thapar has revealed in no uncertain way the typical Harappan features-a fortified citadal together with a city also probably fortified, laid out like a chessboard, with arterial roads and lanes, characteristic pottery and other objects of daily and ceremonial use, such as ornaments, tools and weapons of stone and copper/bronze, toys, weights, and seals, and a cemetery outside and away from the habitation.

Though in a general way all this conforms to what we know of the Indus Civilization, still Kalibangan, has revealed certain new features.

First, there are the usual two habitations, one called "The citadel" on the western side located on the earlier pre-Harappan settlement overlooking the ancient Sarasvati. It is a coincidence that in all the three sites Harappa, Mohenjodaro and Kalibangan the citadel is located on the

western side and that too on a previous habitation? The other is situated towards the east, at a little distance from the first, right on the sanday plain. It appears now that both these-the "citadel" as well as the "lower city" were enclosed by a separate mudbrick fortification wall. Of the city fortification only the east-west wall running for nearly 23 m, (over 80 ft.) has so far been exposed. The north-south wall is not yet fully laid bare. Within the city so far five north-south and three east-west roads, and a number of east-west running lanes have been explored, showing how well-planned the city was.

The roads and streets were found to be clear of any intrusions from the house-owners, and squatters–a civic feature which is becoming rare all over India today.

Whether there were too many carts moving in the streets or not we do not know. But to avoid damage to the houses at street corners, by the sudden turning of the cart, wooden fender posts were provided, a few of which survive.

Rectangular platforms outside some of the houses seen to have been made for two purposes. Either as outdoor rest-places, or contrivances specially made for mounting over an animal's back, or rests for labourers carrying heavy load over their heads.

Such well laid out streets were uninstalled, except in the late phase of the city, nor were they provided with

regular drains, as in Harappan cities. However, the houses had drains made of either wood scooped out in the shape of 'U', or more often with baked bricks. These drains emptied themselves in the soakage jars, embedded in the street floor. It is observed that each house at least two or three streets, as in Chandigarh, for instance. Normally only one, the corner house, can have such a frontage, but others at the most two, a front and a back one, that tool if there is only a single row of houses is a street or a lane. Kalibangan in Harappan times must have been not only well planned, but not densly inhabited, so that there was only a single row of houses in each street, and this again, divided into several small blocks, so that many houses had three frontages. Was or is it desirable to have a house open to so much light and air in a region like N. Rajasthan ? Or was it after the current fashion, as today in Chandigarh ? Even internally the houses were well provided with light and air. For they were built on the **Chatuhsala** principle, that is there was a central courtyard, at times provided with a well, and six or seven rooms on its three sides. There is some evidence to say that these earliest houses in kalibangan were storied for in one house, were preserved stairway has been found.

The roofs of these houses were probably flat. As today in Kalibangan and many villages in Rajasthan, the houses were built of mud-bricks. The size of which was 30 cm. X 15 cm. X $7\frac{1}{2}$ cm. That is the length was twice the brea

and the breadth was twice the thickness, the proportion being 4:2:1. However, the Rajasthan and Harappans were judicious. For they have consistently used baked bricks in door-sills, wells and drains, all places where the wear and tear was much, and the structures liable to be damaged if baked bricks were not used.

This commonsense is again witnessed the way the floorings of houses are made. Unlike Mohenjodaro and Harappa the floors were made firm by ramming (called Koba), and sometimes capped additionally with mudbricks or terracotta nodules.

However, in one case, the floor is found paved with tiles, bearing the typical intersecting design of circles. Exactly similar design occurs at Kot-Diji in what is called a "bath tub".

While there is no doubt about the existence of this design in the tub-like large vessel at Kot-Diji, it should be ascertained, if not already done, whether at Kalibangan it is a real flooring or it too is a part of a tub. Anyway, this is most interesting feature which does not seem to be merely ornamental, but perhaps of some religious significance. Else some other design would have preferred. For we know this was a favourite design with the Harappans, and occurs on the graceful vase.

The Bikaner Harappans thus show considerable originality even in the make up or construction of their

houses. This is further illustrated by three other features. All these are seen in what is called the "Citadal Mound".

The exposed fortification in this mound makes it look roughly like a parallelogram on plan, exactly as at Harappa[1], that at Mohenjodaro, is not fully exposed, but would probably be of the same shape.[2] This was divided in two almost equal halves. Each half may be described as a rhomb. Again each of this rhomb was enclosed by a fortification wall. The width of this wall was quits large, as much as 7 m. (about 20 ft.) at places, the minimum being 3 m. (10 ft.). This wall was further strengthened at intervals with rectangular salients (projections) and towers. The wall, it would appear, was built in two phases or twice. For initially very large bricks measuring 40 X 20 X 10 cm. were used in its construction. Later the normal sized bricks (30 X 15 X $7\frac{1}{2}$ cm.) used in civic houses were preferred.

The southern rhomb is found to contain five to six platforms of mud or mud bricks each separate from the other, and different in size, so that the space (passage) between the two platforms is never uniform.

Nowhere are these platforms connected with the fortification wall. Access to these platforms had to be by a flight of steps, which rise from the passage between the platform. Further the passage fronting the steps was paved.

1. Cf. for Sir Mortimer Wheeler, The Indus Civilization, Third Ed. 1968, p. 29.
2. Ibid., Fig. 7.

These mud or mud bricks platforms seem to be quite different from the platforms at Lothal, Harappa and Mohenjodaro for instance. The latter were largley built for protecting the superstructures from recuring floods. But at Kalibangan they seem to have a religious function, though this cannot be ascertained, for except in one case the superstructures have disappeared. Or is (was) it because it had by this time become a custom, convention or fashion to build the citadel on artificial mud or mud brick hillock ?

In the one surviving example was found a rectangular pit (1 X 1.25 m) lined with baked bricks. This **Kunda** contained bones of a bovire and antlers, perhaps a sacrifice was performed. This suggestion is strengthened by the fact that adjoining the **Kunda** was found a well and a "fire-altar".

A row of such fire-altars was noticed on another platform and also in many houses in the "Lower city". These "fire–altars" invariably consist of shallow pits oval or rectangular in plan. Fire was made and put out **in situ** (that is there and then), as proved by lumps of charcoal in the town part of the pit. In the centre of the pit was fixed a cylindrical or rectangular (sundried or prefired) block. Around or near about were placed flat triangular or circular terracotta pieces, known hitherto as "terracotta cakes".

Such a "fire-altar" has also been noticed by Casal at Amri in Sindh, and something similar was but perhaps not identical was found by Rao at Lothal. Perhaps such fire-altars also existed at Harappa and Mohenjodaro, but

were missed in mass digging, and have only been revealed in a slow, careful excavation, under the supervision of a trained officer.

That here in this platformed, well fortified enclosure, we have the first traces of a religious building with houses for its priests on the site is also borne out by the fact that no large, broad streets have been so far found within the citadel. In fact, there is no form for any vehiculer trafic. So we have to presume that either everybody walked, or some people–like the priests and the like or the ruler–were carried in a palanquine. The general public could go to these platforms form the southern side through a stairway which ran along the outer face of the fortifications wall between the two centrally located salients. A similar arrangement was made for the residents in the northern half of the "Citadel".

At all the three sites, these citadels are built over a littel higher ground, which at Harappa and Kalibangan is proved not to be quit natural but due to the remains of an earlier habitation. However, the elevation was further raised of mud or mud brick platforms. And this at Harappa and Mohenjodaro (and lothal) is explained as a precaution against recurring floods. But at Kalibangan there is (so far) no evidence of a flood, and again the platforms are on separate blocks with a paved flooring in the passage. Further, the fire-altar, like structures, and the sacrificial kunda on these platforms. All these features make the

excavators feel (and I agree with them) that these are truly religious structures. Did they have a similar function at Mohenjodaro and Harappa ? Or there was the real need of a mud brick platform as a protection against floods, and this functional feature was later mechanically copied at Kalibangan.

Thus the discovery and careful excavation of a Harappan city-perhaps a third capital in Rajasthan—seems to clarify and amplify our knowledge of the Indus Civlization. Hitherto it was believed that the Citadels at Harappa (which has also a parallelogrammatic plan and had fortification wall around) and Mohenjodaro, not yet fully laid bare, were the residence of the ruler and the elite (or priests), and had probably also some religious structure within it.

The smaller, portable objects atleast once again the rich and comfortable life which we are now want to associate with the Harappans. A varied and beautiful pottery (its manifold uses for eating, drinking, storing could be imagined if the numerous platters, dishes and other vessels found intact in a grave are drawn functionwise) – Ornaments–beads and bangle-in shell, terracotta, semiprecious stones and faience, and some in gold (?), weights and measures (one in graduated scale as at Lothal), the undeciphered seals including one cylinder seal, with half human-half animal figures on it recalling Sumerian contact and features, and above all exquisite figure sculpture in the round of a charging bull. [1]

1. Cultural Forum, July 1967, facing p. 841

There is nothing specific to tell us about the Harappa religion, except the so called fire-altars and the kunda, and an oblong terracotta cake, incised on both sides with a figure which reminds us once again of the figure in gold in Hissar III, and a painting on a pot at Kot-Diji from the junction layers.

The incised figure seems to be a bull-headed figure (god) with large incurved horns. To some extent we are familiar with a horn-headed deity from the famous Pasupati-like seal. But there the horns are not quite clear, and hence some scholars doubt its identification. But in the Kalibangan figure there is no doubt. And this I have shown in an article can be derived from the moufflon (or wild hill-sheep) head in gold from Hissar in Iran through a painting of a bull's head on a pot at Kot-Diji in Sind.

The Kalibangan Harappans were both vegetarian and non-vegetarian. Wheat and barley they must have eaten, though so far no remains of these cereals have been found in abyway, (that is the charred remains of grains, or impressions of husks in pottery etc). Among the animals they knew and probably cooked for food, the largest percentage is that of humped cattle (cow/bull), then Indian buffalo, pig, **barasingha**, elephant, ass (domesticated), rhinoceros and camel. The last camel is again important, showing the antiquity of this animal in this region (Sind and Rajasthan).

Big and large the Kalibangan Harappans buried the dead as at Harappa and Lothal. A regular Cemetery, 300 m. (about 1000 ft), west-suth-west of the citadel has been found, on the present flood plain of the river. Not only this cemetery sheds some light on the different burial practices current at Kalibangan. but the varying provision of grave goods, and the construction of the graves enlightens us about the social stratification prevalent in the city.

So far the three types of graves have been found. In the first type, whioh seems to be fairly frequent, we have an oblong pug in into the ground. The head body was lain in the pit in . n extended position with the head towards the north and the feet towards the south. Then around the head were arranged pots, dishes, platfer, small vessels, cups . . but not large storage jars . . in one numbering.

This illustrates that there was no fixed number of pots which one had to provide for the dead. If one could afford, and probably belonged to a higher social order, he could keep a large number Besides pots, at times a ooppen mirror was placed near the head. This is further proved by the fact that this particular grave had a lining of mud bricks on all the four dides, which were then plastered with mud from inside.

In the 2nd type of the grave-pit was oval or circular or plan and contained besides an urn, other pots including platters and dishes-on-stand.

Here again the number varied from 4 to 29, depending upon the wealth (and position) of the person. Again, besides pottery, ornaments such as beads, shell, bangles and objects of steatite were kept.

In the 3rd variety, the grave-pit was rectangular or oval on plan with the larger axis oriented north-south, but curiously contained no skeletal remains. Usually nothing but pottery was found within these simple pits, though in one case a shell bangle and a string of steatite disc beads and one of carnelian were found.

This is the first time that burials without any human skeletal remains have been found in a site of the Indus Civilization. But the reason behind this non-occurrence is not easy to gauge. Is it because that there was the custom of cremation-cum-burial, so that the body was burnt, and later only its ash and a few bones were buried in the urn, or even these were not kept but thrown in the river or sea, as some people do today ?

Kalibangan has also provided a very interesting example of ancient medical belief and surgery. In a child's skull were found six circular holes. These holes were made while the child was alive, for the wounds made by these holes have healed, that is the edges of the holes have not remained sharp, as when first cut

This practice of boring holes in the head while alive is called "trepanning", and was widely current in prehistoric

times in Eurpoe, about 3,000 B. C., and was still witnessed in some of the aboriginal tribes of Peru in Central America. "Trepanning"was resorted to,it is believed,to relieve headache, and alliviate inflammation of the mastoid (conical prominence) in the temporal bone to which the muscles are attached.

So far the only example of "trepanning" we had, was from Langhnaj in North Gujrat. Kalibangan has provided a second one. These, thus, give a wide base to a belief and practice current in Europe and Africa, some 4,000 years ago, exactly the time it was prevalent in Western and Northern India, including Gujrat, Sind and the Punjab.

Thus Kalibangan has given us considerable food for thought. Again the paved road and flooring. There are new features not so far met with at Mohenjodaro. But we must also note the absence of certain well-known features, such as street-drains, and among the portable smaller objects the compete absence of lingas, yonis, and figures of mother-goodesses. This is also a feature of the Lothal (a Surashtra) Harappa, and thus underlines the importance of Mohenjodaro and Harappa as "religious capitals" as well.

In many respects then the Rajasthan Harappan has a distinct individuality. It is not a exact copy of the Indus. Such a regional variation is but natural, though it would be worth inquiring who introduced or brought about this variation viz. the indigenous element in the population or because some of during migration from the centre, the original features got lost or changed.

Before leaving the Indus Civilization, a question might be posed. Was this (and the still earlier pre-Harappan or Kalibangan-I culture) indigenous to Northern Rajasthan or the Sarasvati Valley ? What would be its relation to the early Vedic Culture, particularly to the phase which relates to the Sarasvati and the Drishadvati ?

The first problem is purely archaeological and requires an archaeological answar. At the moment, we have no means to trace the birth and growth of both these cultures in the Sarasvati Valley, or even Sind and the Punjab. Both are made up of partly foreign -Baluchi and Iranian elements-and partly Indian elements. The ancestry of the former can be roughly traced in Iran and Western Asia, but that of the later we cannot do.

For this requires deep digging at Kalibangan or some such site to get at still earlier phases of the pre-Harappan Culture. If this cannot be found, then we shall have to conclude that the pre-Harappan and the Indus Civilization were full scale colonizations by a people frcm Iran and Western Asia.

However, we should not be so much pessimistic. The discovery of the pre-Harappan is hardly 10 years old. And within India itself we are discovering earlier and earlier cultures, almost every year. Two years ago, a painted pottery culture with rich copper/bronze equipment was discovered at Kaitha, 15 miles from Ujjain. This is dated by Carbon 14 method to C. 2,100 B. C., that is almost contemporary with

the mature phase of the Harappan. Likewise a Carbon-14 date for a Neolithic Culture from Eodikal, Mysore State is C. 2,400 B. C.

So if we persist, and work in a planned, coordinated way, we are sure to discover the indigenous elements in the pre-Harappan and Indus Civilization.

The Aryan Problem

Whether we find the traces of earlier culture, or not the present evidence indicated that the Sarasvati–Drishadvati Valley was inhabited by atleast 25,00 B C, Who lived there? The Vedic Aryans? Though no definite answere can be given, unless the Indus script is deciphered, there is evidence now that the Harappans did have some sort of sacrifice and that the pre-Harappans were partly from Iran. Thus there is some hope, a possibility, that the earliest inhabitants of the Sarasvati Valley might be the Vedic Aryans or a people from Iran, that both these might represent different Aryan waves. The Aryan problem has not been solved. On the contrary these new discoveries in Sind, Rajasthan, Madhya Pradesh and Maharashtra have re-opened it.

Something what happened in Northern Rajasthan also took place in Southeastern Rajasthan in the Banas Valley. It was a colonization by a people from outside. From where exactly we do not know. For the moment we are unable (or rather we have not enough evidence) to discern its development from earlier beginnings in the Banas Valley itself. Very probably a people using microliths, and possibly,

some pottery, but for all practical purposes nomadic hunters, having temporary camps on the flanks of the Arvallis did exist.

Then at Ahar, Gilund and some 50 other sites, a distinctive pottery, and remains of houses with stone plinths and mud or mud brick walls with huge boat-shaped stones, known as saddle querns (**patas or sila batta**) came to light. This pottery had a black top, and reddish bottom, with paintings in white on the black surface. Because of this distinctive features, Ahad, where it was first noticed by Shri R. C. Agrawal, was called the Black–and–Red culture. This is in a way true, because this was primarily the pottery which the inhabitants of Ahad used for eating and drinking. It was a fine, **de luxe**, table ware, like the China Ware , or stainless steel ware we use today. However, subsequent larger excavation showed that the Ahad people produced other fine and distinctive pottery as well. Above all we got some insight into the economy of these people.

Why should a totally new culture or civilization take its birth in this secluded, hill-grit region ? No doubt it is beautiful, and the manmade lakes and palaces within it have made the Udaipur region still more beautiful.

Since our work at Ahad I have been studying this problem from various points of view-historical, archaeclogical, geographical, environmental and economic. Of these the geographical is quit important.

Udaipur and its environs are surrounded on three sides by hills, only the northeast is comparatively open, which through Chitor leads one on to the Chambal and Yamuna Valleys. Otherwise the only other routes for coming in and going out are the various ghats, of which Haldighat is justly famous. It is through these ghats and the open area in the northeast that various ruling dynasties entered this region, mostly as refugees and conquerors. The earliest known historically are the Guhilas who came here in the 8th century, probably from Valabhi in Saurashtra. After nearly 700 years the Sisodiyas took advantage of this naturally fortified region when pressed by Akbar.

This is known history. But excavations at Ahad and Gilund, and the discovery of 50 other sites in the Banas Valley tells us that man was here at least from 2000 B. C. And the question is why ? The region is fairly fertile, though soil cover is not much, because unlike Western and Northern Rajasthan it receives regular rains. The forests provide game, some fruits–particularly Mahuda flowers and good wood for building houses. But more than that the ancient hills around Udaipur contain copper, and other minerals. How man discovered this fact we do not know, but we can tell you when probably he did. And once he discovered copper here, he continued to live here for centuries, until his successors made another important discovery, viz. that of iron. Thus according to my interpretation of the evidence from Ahad excavations, it was copper, which served as a

magnate to attract man to this beautiful, hill-girt valley of the Banas.

This man settled down on the bank of the Ahad river, not on the rock, but on the fine silt which the river had laid down, when it flowed in the distant part some 20 ft. above its present bed. And he made full use of the environment, his surroundings. Instead of making simple mud-walled houses, he made a plinth of schist stones which was on its doorstep, just under his foot. This plinth was nearly three ft. high, quite smooth and regular from outside. On these stone plinth were built the walls of houses. These again were fairly large, with atleast one or more rooms made by partition walls. The one peculiarity of about prehistoric that we have noticed is that the longer axis of these houses was from north to south and the shorter from east to west.

Though the plans of houses changed, the inhabitants continued to live on for nearly 1500 years, from C. 2000 B. C. to 500 B. C. at the same place, on the ruins of the earlier houses. Thus a mound was being formed, for the level of the habitation which was formerly our about 15 ft about river, gradually rose to 50 ft.

These prehistoric houses at Ahad were furnished with the most essential things that any Indian or a house of this period would be. Thus there was a large two-mouthed **Chula**, a huge board-shaped stone slab, called saddle quern (**sila-batta**) for grinding grain (and not masala), and

variety of pots and pans. Possibly there was some wooden furniture, which has now disappeared.

Just as we have had special vessels for eating food and drinking water and milk etc. made either of copper/ bronze, then brass, sometimes "german silver," and now stainless steel, so these first inhabitants of Ahad had thalis, katoras and 1 lotas which were partly black, and partly red from outside, and in addition were decorated with white paintings on the border. It is not easy to make such black and red pottery. It required a special technique, either by double firing, that is first making the post red or black and then making them black or red at the edges by the application of charcoal, or by an inverted firing technique.

But why this insistence on peculiar colour and form, and that for nearly 1500 years ? Behind every such specialized form, or colour of pottery, there is always some ethnic, religious, regional or some such cause. Take for instance the modern fashion in men's wear very tight trousers, these can be traced to Italio-American influence. The introduction of stainless steel and the still earlier vessels of ' german silver" to the rapid development in metal technology in the west. In the same way pottery very often is an index of ethnic or regional or religious group or some technological development. What this Ahadian black-and-red pottery stands for, we have not been able to ascertain. One scholar thought since it comes close after the Indus Valley Civilization, and since a few of its pottery

forms resemble the forms of vessels or this civilization that it belongs to a group of Aryans. Thinking in the same strain, I have suggested that it might be called broadly the Yadava country, or the Salva country, according to Pargiter.[1] These are however speculations. What is certain, is that this Ahad pottery is quite distinctive and since it is found in no less than 50 sites in the Banas Valley, in the districts of Udaipur, Chitor and Bhilwara does mark off from the similar distinctive cultures of Malwa in the east, Gujrat in the south and N. Rajasthan in the west.

At one time it was thought that this black-and-red pottery was the only distinctive feature of Ahad pottery and culture. This view was based on very limited evidence. The excavations in 1961-62 showed that the Ahadians produced many other distinctive pottery vessels and fabrics, besides the black and red ware. While the vessels for cooking and baking, such as tavas and small handis were most ordinary, coarse and rough, from both surfaces. Larger vessels were for storing water, grain, and other household objects, such as cups and lotas, were very carefully decorated on their neck and shoulder, leaving them quite thin and rough from the belly downwards. Normally the large storage jars and medium ones are not painted or decorated below the belly downwards, but they are simply smoothed. At Ahad on the contrary they were intentionally roughened. This was novel feature. Its explanation was had

1. Sankalia, H. D. "Traditional Indian Chronology and C-14 Dates", Indian Prehistory-1964, P. 224.

when in one house, we found intact pots, which were more than half buried in the ground. In Gujrat, where water pots are kept in this way, it is called **Paniaru.** Thus the roughened surface would never be ordinarily seen by people in the house or outsiders. The shoulder and the neck of the pot was most artistically, at times profusely, decorated. These ornamented portions of the vessels showed up, and thus contributed to the general room decoration. Usually we find only one form of decoration on pots viz. Painting, or *applique, incised, grooved or ribbed types of decoration.* But at Ahad, all the three or four types of decoration viz. the applique, incised and grooved, are found on the same pot. This profusion of ornamentation on pottery again reminded me of the Bhill women's love of ornaments on every part of the body.

The Ahadians had thus large houses with several rooms. And they were well stocked with pots and pans for cooking, eating, drinking and storing.

How did they live and what did they eat ? It appears that the chief occupation of the inhabitants, or a group of it, was the smelting of copper-ore and making of copper and other objects. For this inference of far reaching importance we had three kinds of evidence. First,the complete absence of small stone blades for cutting and piercing purposes. These blades found in their hundreds in all the contemporary cultures of Penisular India, for instance in the adjoining Navdatoli-Maheshwar where the number was no

less than 23000 in the final count. Identical thin blades, but larger in size are met with in the Indus Civilization. At Ahad we got not more than six of these blades and a couple of cores, both obviously obtained from the same early or contemporary Stone Age sites.

Secondly, the occurrence of five copper axes and a copper sheet, in two widely separated different parts of the habitation.

Thirdly, the discovery of copperslag in a specially made pit in one of the houses. Fourthly, the existence of several ancient copper working within a radius of 10 to 15 miles from Udaipur.

Thus there is both positive and negative evidence to aver that the Ahadian lived by smelting copper and that too right from their first arrival at Ahad.

This inference was further tested by Dr. Hegde of the Baroda University. He analyzed the copper ore from Khetre, the copper slag from the excavation and the metal from one of the copper axes. And he concluded that their is reasonable ground to belive that the Rajasthan Copper ore was used. Dr. Hegde has further arrived at some intersting conclusions about the technique employed by these earliest known copper smelters of India.

The copper axes were made by probably casting in a sandmould. The mould had no proper ventilation for allowing gases to escape. These were therefore trapped within the

metal, giving rise to gas holes, formation of cuprous oxide and porosity. These defects could have been removed if the casterns could have subjected to cold hammering. But they were left in a cast condition, Hegde therefore concludes that though the Ahadians were efficient in smelting and pouring metal casting was not well advanced.

If Ahad was smelting copper and fashioning copper as early as 2,000 B. C., that is some 4000 years ago, was it for its own people. or others in Rajasthan, or for other parts of India, particularly its neighbours, Malwa and Gujrat, both which do not have any copper ores ?

For if Ahad bartered copper axes with the neighbouring regions, it should have received something in return as well. Except a bit of pottery of Rangpur type from Saurashtra, and forms of pedestal dishes, or dishes with highly decorated stands resembling those from Indus Civilization, there is very little of any imported meterial to say positively about these external contacts of Ahad with other parts of India. If it supplied copper axes to Malwa or Gujrat or to Sindh, and Punjab, then the composition of these copper and minerals has to be compared with that of Ahad. Then only something more positive can be said.

While we are not sure about the interai contacts of Ahad, of its foreign contacts we have evidence which can be described as tantalizing, It is very suggestive. For the affinity between Ahad and Troy and other sites in Turkey,

and Central Asia are very close, the vast, intermediate regions so far remain unknown. Hence this affinity cannot be explained at present. What does this affinity consist of ?

Evidence of this contact with or migration from such distant city as Troy is given by 38 terracotta (burnt clay) **Supari** (arecanut) like objects. These might be beads or spindle-whorls, that is burnt clay **taklis** for spinning. Unlike hundreds of similar objects, these beads from Ahad are minutely incised or bear punctured decoration, on their globular surface. Eight of these punctured decorations consisting of latticed triangles, slanting lines, groups of wavy and punctured dots are identical with for these from Troy. One Ahad bead had an incised figure of a strylized stag or deer, which can be compared with that of Anau in Central Asia.

This is not all. Further, a few pottery forms, such as highly ornamented stand of a dish, handles of pottery in the shape of animals, remind us again of similar forms at Troy and at Shah Tepe and Tepe givan in Iran. Both Troy and Shah Tepe are as old as or slightly older than Ahad. So there is nothing surprizing if a group of people on their way to Rajasthan from Westren and Central Asia had brought these features from these distant lands, or sent them as trade goods which is not unlikely, as this smaller number suggests.

One more item, in fact an essential, connected with the life of the people at Ahad is the occurrence of large and

numerous flat-based, boat-shaped, stones and exceptionally large **chulah**, sometimes more than one in each house. The former definitely indicate that the ancient Ahadians used some cereal, like wheat which was pounded on this silas (querns).

In order to find out how efficient these **silas** were we got pounded 2 lbs of what on of these silas. Within an hour we could get 2 lbs of wheat, over 50 percent of the resultant flour being fine and the rest coarse.

The large, two mouthed **chulahs**, almost like the present ones, suggest that the pepole were quite affluent and ate more than onc dish at a time. While the exceptionally large one, with five arms, and four cooking positions might be for a very large family or community kitchen. Unfortunately the full evidence of their content does not survive. We could find only a trace of rice, and **Jwari**.

The latter was not known before the 5th century B. C Only rice was known and eaten from about 2nd cenutry B. C.

Now rice is not normally pounded and eaten, so we presume that wheat must have been eaten. For it was known in the neighbouring Malwa as well Sind and the Punjab. However, as far as the antiquity of rice is concerned, Ahad is the third site in India where rice as old as 1800 B. C. has been found, the other two being Lothal and Navdatoli. Later it was found at Rajar Dhipi, in W. Bengal. Thus Hastinapur

rice becomes the latest, though it was the first site, to yield the evidence of the use of rice.

Though the prehistoric Ahadians thus knew rice, wheat and probably Jwar and other cereals, still meat diet consisting of pock, beef and venision, fish and tortoise formed a considerable portion of their daily food, for in every house we excavated, we encountered large quantities of bones of goat/sheep/ox/cow/pig, and fish and tortoise.

This way of life, living in long rectangular houses, with plinths made of schist blocks and walls of mud or mud brick, with one or two partition walls, giving several rooms, the kitchen provided with large two-mouthed chulahs, saddle querns, and rows of storage jars sunk into the floor, so that only their decorated tops would jut out, and the inhabitants dependent upon animal husbandry and cultivation of rice and wheat, but above all smelting local copper, and forging copper sheets and ores, lasted for nearly 1500 years. No doubt, there were some changes during all these centuries. When the houses became old, new ones were built, on the ruins or debris of the old ones, by merely levelling the broken mud heaps and changing the plans but keeping the north-south axes. Thus the occupation level rose century by century, so much so that when the Iron-using people came in about the 4th century B. C. they settled on a regular mound, which was nearly 40 ft. high from the water level.

This put an end to the earliest copper-smelting and truly Copper Age city in India. But its memory lingerd on in the

minds of the people from generation to generation, and became the foundation of the legend of "Tambavati." Dhulkot is indeed a recent name given by pepole who saw nothing but heaps of dust and earth.

There are also legends of other Tambavati Nagaris in Rajasthan recorded by Carlleyle.[1] These should be now examined for such sites might be hide in their wombs, the traces of other copper-smelting cities in Rajasthan.

Back to Sarasvati Valley

While in S. E. Rajasthan, in the valley of Banas, once the civilization took its birth, it continued to develop with a few changes in pottery until the advent of the Iron Age in about the 4th-5th century B. C., in the Sarasvati Valley there was a clean break, while Jaisalmer-Jodhpur region is still terra incognita. We really do not know what happened or did not happen in this western most part of Rajasthan. But in Northern Rajasthan the Harappan or the Indus Civilization gradually vanished. Still we do not know the causes of its disappearance. Once Aryans were accused by Sir Mortimer Wheeler, for destroying this civilization. Though this view is still maintained with some modification, it is no longer popular.

1. **Report of Tour in Eastern Rajputana, ASI.**, 1871-72 and 1872-73 (1966) pp. 116, and 162 respectively. He mentions Chatsu about 40 miles south of Jaipur, and Nagari, near Chitor, as Tambavati Nagaris. These are not far from khatis. In fact a fresh survey from this point of view is now necessary. Chatsu had extensive mounds, and so also Nagar or Karkota Nagari.

Whatever it be, Shri A. Ghosh who explored the Bikaner area in 1951-52, observed that the people who made the painted Grey Ware and the Black and Red Ware did not occupy the deserted settlement of the Harappans, but preferred to remain a little away from them. Thus the settlements of these later people were invariably of an inconspicuous nature.

Excavations at one or two sites like Sardargarh, have also shown that the mounts are small, because the people who inhabited these sites were comparatively much poorer than their distant predecessors, the Harappans and their distant successors, the Rangmahal people. Unfortunately no painted Grey ware site is fully excavated and we do not know their culture so well. From the evidence at Hastinapur, Atranjikhera and now Noh near Bharatpur, we can difinitely say that the people knew iron, ate rice among other cereals, and also cattle including cow/ox, and were acquainted with the horse.

These features, particularly the remains of the house from their settlements and the association of the numerous PGW sites with the sites mentioned in the **Mahabharata** induced Shri B. B. Lal, to propound his famous theory that the Painted Grey Ware people were probably the Early Aryans, and secondly that the **Mahabharata** battle was fought in about 1000 B. C. Since its announcement in 1954–55, a number of things have happened. First the 6–14 dates from Hastinap

have consistently ranged around 6th–7th century B. C So also of other sites like Ahichhatra. Only one data from Atranjikhera goes to 1100 B. C. Secondly, traces of cultures much earlier than the P. G. W. have been found all over the Punjab, and western U. P. Thirdly, the date of the decline of the Indus Civilization has been pushed back by three to four centuries, about 1,700 B. C. It is no more 1500 B. C. as formerly believed. Thus a wide gap still exists between the disappearance of the Harappan Civilization and the appearance of the Early Historic kingdom in U. P., M.P., Punjab, and Raiasthan and, this the P. G. W. cannot fill up. For it seems, according to the present evidence to have flourished just before the Early Historic kingdoms. This is also indicated by the unifrom association of the NBP and iron with the P. G. W. in its top layers.

Taking all these developments into consideration it was thought in the symposium held on the Painted Grey Ware at Aligarh that the P G. W. culture most probably belongs to 6th–8th century B. C. and if it did represent the Aryans, these would not be the earliest Aryans, but one of their latest group does not seem to be connected with the people from the Shahi Tump cemetery in Baluchistan or the people from far off Sicily, as first thought by Shri Lal.

This re-checking of the P. G. W. and the Aryan problem has a direct bearing on Rajasthan, where on the banks of the Sarasvati–Drishadvati many of the Rigvedic hymns were composed. Here, as I said before, had also flourished the

Harappan and the pre-Harappan, the later showing considerable Iranian influence. The question then arises can the pre-Harappans lay claim to any relationship with the Early Vedic Aryans ? I would keep an open mind. There is also some evidence to say that people of Navdatoli and of prehistoric Malwa are the pre-Harappans who were displaced by the Harappans. Hence the occurrence of pottery with the pale red, comparatively thin walls with certain characteristic designs, and above all goblets in the pre-Harappan and the Navdatolian.

Prehistoric Indian Archaeology is at such a stage of infancy that we have to keep an open mind. For if my tentative view finds further corroboration then we might have to regard both these culture at pre- Vedic or Early Iranian.

So far the trend has been to derive all these cultures beginning with the pre-Harappan,Harappan, the Black and-red Ware, the Painted Grey Ware from outside India. If we shall have to conclude that there were colonization by outsiders or foreigners in different parts of Rajasthan.

But should we always think in this strain ? Was an indigenous development not possible ? This question siezed me most forcibly when seven years ago, while excavating at Ahad, I was struck by two things. First that the houses of the Bhils and Minas who live at Pala village, near the foot of the Dhulkot mound, were built exactly and the houses built by the Ahad people some 3,000 years ago. Long rectangular houses with mud walls but Plinths of schist. These walls

additionally carried a large number of quartz nodules, inserted eithter to beautify the walls or to strengthen them, or as the Bhils, sand mixed naturally with the earth, without any reason or motive. Further, the preference of the Bhil women for saris or Bandhanis with beautiful and delicate "tie and dye" work. And this recalled to me vividly the characteristic Black-and-Red Pottery with white paintings from Ahad and the Banas Valley. I asked myself whether the Bhils were the original inhabitants of Ahad or whether they copied or inherited 3,000 years tradition, or whether this correspondence was quite fortuitous. No answer could be given satisfactorily. Careful and prolonged investigation had to be made among the Bhils and other inhabitants of Pala and other neighbouring villages. The work was entrusted to one of my pupils Kumari Malti Nagar. She lived among the Bhils for several months, studied their house plans, pots and pans, their customs and rituality, and also the objects from the excavations at Ahad.

Malti Nagar's careful comparative study showed that (i) the Bhils have no memory at all of their relationship with any earlier culture at Ahad; (ii) the Bhil pottery etc. is quite different from the excavation at Ahad; (iii) the house plans do correspond admirably with those unearthed at Ahad; (iv) there is some correspondence in design between the Bhil Bandhani decoration and the designs on the Black-and-Red Ware.

Thus the problem has remained open. No final conclusion

could be reached. And this is not only with regard to Ahad and the Bhils, but with other prehistoric cultures and adivasis as well. For instance the people in the Narmada Valley, build round or rectangular huts with closely set wooden posts, exactly as they were built at Navdatoli, opposite Maheshwar, some 3500 years ago, and so also at Tekkalkota, in Bellary District. But in both these example, as at Ahad, the pottery of the **adivasis**, and the prehistoric people is strikingly different in shape and technique.

Such a wide range of pots and pans, different sizes of storage jars, smaller vessels, and dishes and bowls, all beautifully decorated by painting, incised, applique and other methods show not only a high artistic sense, but many more needs which one does not behold in any **adivasi** household today, whether these be Bhils, or the Gonda.

The conclusion is therefore inescapable that the inhabitants of Ahad and Navdatoli were comparatively more advanced than the Bhils or Gonda, though they did not know iron.

Enough has been said to demonstrate how complex the problem of origins of these prehistoric cultures is. More intensive work on the lines indicated here might help the final solution.

Thus the available or hitherto known archaeological date permits us to present a picture in faint outline. Of the

first arrival of man in three physiographical divisions of Rajasthan. The time of man's arrival in each of these three divisions is different, because of varying physiography. Almost all the stages of man's birth and developments are witnessed in S.E. Rajasthan, that is right from the Early Stone Age to the Early Iron or Historicai period; whereas in Western Rajasthan so far we know about only the 2nd and probably the third stage, In the Northern Rajasthan again, the first three stages are not hitherto known, and we are suddenly face to face with the beginnings of a city civilization, its sudden decline and the re-appearance of a culture, which at best can be described as of farmers and pastoralists and not city dwellers and thus deserve not the name of civilization in an anthropological sense.

Since in each case all the steps are not known, I have taken the liberty to call each stage a colonization, that is the arrival of a new people, with the readymade knowledge of the arts and crafts characteristic of that period. This appraisal of the present knowledge may not appeal to some scholars, particularly in these days of the racial or regional pride. To such scholars, I can only say that the view is strictly provisional. It can be set aside or modifies, when more data is obtained.

Now, a few words about the historic archaeology of Rajasthan I made only a passing reference to it at the outset but I have not referred to it in detail. This is because so far no systematic study of the rich archaeological treasure of

pertaining to this period has been made as to present a coherent picture. No doubt, we have two excavation reports, and several articles and a thes is devoted to the place and personal names in inscriptions of Rajasthan, But all this knowledge needs to be digested

There is a great need for a work like the **Archaeology of Gujrat**, where I have attempted an integrated study of Coins, inscriptions, temples, sculptures, architecture, iconography and instead of one, we may have first three separate studies devoted to each division that is the archaeology of western Rajasthan, the archaeology of S. E. Rajasthan and the archaeology of Northern Rajasthan.

But such a study cannot be lightly undertaken. The students must have an adequate knowledge of Sanskrit, Prakrit, and architecture, sculpture, iconography and numismatics. Then only real justice could be done to the subject.

More important, much of the material is unpublished and lying in the field, in far-off places, and museum in Bikaner, Jodhpur, Udaipur etc. So the persons must be willing to go to distant places, and training, before undertaking this field work, and must have had sufficient knowledge of drawing and photography. If these requisites are fulfilled, we can expect a first class work on "The Archaeology of Rajasthan". With two or more Universities and Research institute like Sahitya Sansthan, this is not a

difficult thing to achieve. What is needed is a band of research workers, who after adequate training should be willing to shoulder this responsibility.

Much remains to be done in the field of prehistoric archaeology. We at the Deccan College have barely touched the problem, only scratched the ground. Many inferences here expressed need to be tested and confirmed. Above all, we should prove that Ahad was a copper-smelting site.

No less than two seasons of excavations of the type undertaken by the Deccan College will be required to understand this problem.

Likewise, small excavations at two or three well spread sites on the Berach to know whether there are any regional variations in the Ahad culture. And if there are variations, what do they connote ? A Marxist would say that these signify different sub-ethnic group living in the Berach basin. From this point of view the unreported Gilund in the Banas plain holds a very intersting position. Similar to Ahad in much of its pottery, it has many more and very intersting features-particularly large brick structures. So a larger excavation is indeed required at Gilund.

Likewise, we should not be satisfied with what Kalibangan has given us. Either here or somewhere in the Sarsvati valley, but preferably at Kalibangan itself the pre-Harappan settlement has to be exposed, and its origins understood. So also the problem of the Painted Grey Ware

and the Black and Red Ware. The present evidence indicates that there were only very small settlements in the Sarsvati Valley. This impression should be testid by large scale excavations at Noh and other sites on the border of U. P, and Rajasthan.

Since my own excavations and explorations in Rajasthan as also that by Dr. V. N, MISRA, Rajasthan has been further explored by Dr. V. N. Mishra and Dr. S. N. Rajaguru and the Director of the Physical Research Institute, Ahmedabad. A few important results particulary those bearing on the climate and the origin of civilization are here given.

The region around the city of Didwana as well as parts of the Thar desert has helped in the reconstruction of the main features of the paleo-environment (that is the oldest climate etc.). This was never drastically different from the present sand dunes were being formed when the man making the first or the oldest stone tools lived here. Between the dunes there were seasonal water ponds.

The most important result of this was that the inhabitants of the region were trained to respect the natural wealth. **And Till Today**, the inhabitants maintain a certain equilibrium (balance) with the environment. Hence cattle breeding and pastoralism or humting for some tribes is a must. Cultivation of grains is possible during the monsoon and where the soil is suitable.

This is illustrated by a long trench excavated in the dune 16 R at Didwana. In this section we have at the bottom tools of the Lower Palaeolithic (3, 90,000-2,50,000) in the middle at 11 m (Middle Palaeolithic (1,44,000+12,000 B. P.) and Mesolithic at the top (14,000-8,140 B P.)

Rajasthan thus holds the key to the understanding of many important problems in our culture and history-both of the historic and prehistoric period. Towards their solution the efforts and resources of the State. Research Institutions and Universities need to be diverted. It is by a cooperative effort alone that something worthwhile will be achieved.

Appendix-1

Zinc Distillation in Ancient India

K. T. M. Hegde, P. T. Craddock, and V. H. Sonavane

INTRODUCTION

Zinc is a soft, white, light, volatile metal. Under one atmosphere pressure it boils at 908^0 C. Though the initiation of reduction of zinc oxide to zinc by carbon begins at 950^0 C, the minimum necessary temperature for successful extraction of zinc from zinc oxide in a retort made up of a refractory material is 1250^{0}C. It ($ZnO + C \rightarrow Zn + CO$-57000 cal.) is a highly endothermic reaction. Therefore, before the advent of modern high pressure technology, zinc had to be, inevitably, produced as a vapor. In an ordinary smelting furnace this vapor would promptly reoxidize to light zinc oxide and be carried up the flue. To overcome this problem zinc oxide has to be smelted with an excess of charcoal powder or any any other suitable carbonaceous matter, in a distillation system composed of a retort, placed within a special furnace, capable of reaching and maintaining the necessary high temperature of 1250^0 C. The retort has to be connected to a condenser placed outside the furnace chamber,

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where zinc vapor will cool down into a liquid and then solidify. The process of distillation and condensation of zinc vapor has to be carried out in a reducing atmosphere, charged with an excess of carbon monoxide, to avoid reoxidation of zinc into "philosopher's wool" (Pompholyx light, smokey, zinc white). A series of impressive, nearly intact, structural remains of furnaces used in the producotion of metallic zinc in antiquity was excavated at Zawar in December 1983. Zawar, 24°21'N, 73°41'E, is situated in Aravalli Range, 48 km South of Udaipur in Rajasthan. The ancient zinc ore mining and smelting settlement of Old Zawar lies beside the Tiri River surrounded by dolomite hills from which sphalerite ore was mined. There are deep mine shafts all around the site and massive heaps of debris built up zinc distillation retorts, furnace fragments and ash.

Before going into a description of Zawar industry, it is perchaps pertinent to point out why zinc was produced in the past. Zinc was and still is extensively used in production of brass, an alloy of copper and zinc. Zinc in vapor from easily mixes with copper. Fusion of zinc with copper increases the strength, hardness and toughness of the latter. When the alloy is composed of 10 to 18 percent of zinc it has the pleasing golden yellow color. It can also take very high polish and literally glitter like gold. On account of this attractive golden glitter, brass has been a popular alloy in India and abroad for over 2000 years. It was specially used for casting statuary and fabricating a variety of useful

vessels for serving food and drink, cooking and storing. Brass sheets were used for covering temple roofs. The alloy was also used for making a certain class of furniture. As Children, many in India will have slept in brass cradles.

The early history of brass is rather obscure. What little evidence is available on the subject is ably summarized by Craddock.[1] At present the origin of the alloys are not known with any certainity. There is literary evidence to show that brass was known as **oreichalkos** in Greece and Anatolia in the midcenturies of the first millennium B. C. In the Indian subcontinent the earliest brass objects were found in the levels dated to the 4th century B. C. in an excavation at Taxila.[2] Taxila (Takshashila) now in Pakistan had a long history as an important trading centre of the Brass. Brass objects in the excavations there continued to occur until the 5th century A. D.

Direct Fusion and Cementation Processes

Brass can be produced in two ways. One of them is direct fusion of copper and zinc. In this process it is possible to control the percentage of each component in the alloy. Brasses containing upto 36 percent zinc are known as 'a' brasses.

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1. Craddock P. T., the Composition of the Copper Alloys Used by the Greek, Etruscan and Roman Civilizations, **Journal of Archaeological Science**, 5 : 1-16, 1978.
2. Marshall, Sir John, *Taxila*, Volum 2, Cambridge University Press, 1951

These undergo easy cold work. Brasses containing more than 36 percent zinc are known as 'a+b' brasses. These are lighter and harder and more suitable for casting statuary. Brasses containing more than 46 percent zinc are brittle.

The other process of manufacturing brass is the cementation process. It is no longer in vogue. In this process, finely divided copper fragments were intimately mixed with zinc oxide and charcoal powder and heated at 1000^{0} C in a sealed crucible. At this temperature a certain amount of zinc vapor was formed which dissolved into fragments of copper yielding a poor quality brass alloy full of many inclusions. In this process it is not possible to control the percentage of zinc in the alloy. Werner[1] and Haedecke[2] have experimentally demonstrated that the brass produced by this process could not contain more than 28 percent zinc. The temperature of 1000^{0} C was crucial to the process. Below 950^{0}C no zinc was produced. If the temperature was as high as 1083^{0}C copper melted and flowed down to the bottom of the crucible forming a puddle there, exposing very small surface area of the metal for alloy formation. These inadequacies not with standing, the cementation process formed the basis of brass industry in Europe from the midcenturies of the first millennium B. C. to the early part of the 19th century A. D.[1]

1. Werner, O, *Spektra lanalytischeund Metallurgische Untersuchungen an Indischen Bronzen*, Leiden, Brill, 1972
2. Haedecke, K., *Gleichgewichtsverhaltnisse beider Messingherstellung nachdem Galmeiverfahren*, Ergmetall, 26 : 229-233, 1973

There is archeological evidence to believe that high zinc brasses were made in ancient india.

A brass vase excavated from the Bhir mound at Taxila, dated to the 4th century B. C., showed on analysis 34.34 percent of zinc.[2] Such a high percentage of zinc in the alloy could have been brought about only by direct fusion of copper with zinc. Here therefore we have evidence to believe that zinc was distilled in ancient India. The radiccaibch dates for the Zawar zinc smelting industry lend support to this view. Let us therefore turn to the question how zinc was distilled at Zawar.

Excavations at Zawar

To seek an answer to the above question a team of archeologists from the M. S. University of Baroda, in collaboration with the Hindustan Zinc Limited, Udaipur and the Research Laboratory of the British Museum carried out an exploration and excavation at Zawar. Zawar has been well known as an ancient Indian mining and metal working site. Travellers including Tod[3] and more recently geologists, such as Mookherjee[4] had commented on the deep mine shafts and

1. Craddock, P. T., A. M. Burnett, & K. Preston, Hellenistic Copper Base Coinage and the Origins of Brass In W. A. Oddy, editor, Scientific Studies In Numesmatics, Pages 853-64, London British Museum, 1980
2. Marshall, Sir John, Taxila, Volum 2, Cambridge University Press, 1951.
3. Tod, J. Annals & Antiquities of Rajasthan, Volume 2. London, Routledge & Kegan Paul Ltd. 1950
4. Mookherjee, A, Geology of the Zawar lead Zinc Mine, Rajasthan, Economic Geology, 59 : 657-677, 1964.

extensive heaps of debris that had accumulated at the site from the past metallurgical activity there.

A survey of the old mines around Zawar revealed that many of them were worked down to a depth of 120. m or more. Their deep shafts opened into many galleries and narrow tunnels following the natural configuration of sphalerite mineral veins at different levels. All the galleries were provided at regular intervals with ventilation holes of $1\frac{1}{2}$ to 2 m. in diameter. Radiocarbon assay of the timber supports found at a depth of 100 m has given two dates for the zinc metal industry at Zawar. They are 2120 ± 60 and 1920 ± 50 years before the present[1]. As these radiocarbon samples come from a depth of 100 m, it is possible to observe that the zinc metal working at Zawar might have started at least a few centuries earlier. More radiocarbon samples are now being analyzed at the Research Laboratory of the British Museum.

The massive heaps of debris formed by the past zinc smelting operations at Zawar are impressive. They are built up of broken spent zinc distillation retorts, furnace fragments and ash. A rough estimate of the debris at the site suggests that they could be of the order of a million tons. It appears that a substantial quantity of zinc was distilled at Zawar over the centuries.

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1. Craddock, P. T., L. K. Gurjar, & K. T. M. Hegde, Zinc Production in Medieval India, World Archaeology, 15 (2) 211-217, 1983

Zinc Distillation Furnace

The excavations at Zawar brought to light a series of impressive, nearly intact structural remains of furnaces that were used in the distillation of zinc in antiquity. These structures enable us to reconstruct how zinc was made in the past.

The furnaces are in two parts consisting of a zinc vapor condensation chamber at the bottom and a furnace chamber at the top. The two chambers are separated by a perforated terracotta plate. Condensation chamber measures 65 cm by 65 cm and 20 cm in hight. The perforated terracotta plate that separates the two chambers is a composite unite made up of four equal segments of 35 cm^2. It is 4 cm thick well-backed, and sturdy. Its perforations include circular holes of two sizes; larger ones of 4 cm diameter, each of which are surrounded by a number of smaller holes of 2.5 cm diameter. Within the furnace the composite terracotta plate was found to be supported on a ledge in the furnace walls on all four sides and a single solid terracotta pillar placed below the junction of its four segments.

Up above the perforated terracotta plate is the furnace chamber. In it 36 charged retorts were arranged, inverted vertically, in six rows, six retorts in each row their condensation funnel tubes passing down into the condensation chamber through the larger holes in the terracotta plate. Thus, the arrangement of the retorts in the furnace at Zawar was strikingly similar to the vertically

inverted retort zinc distillation process, **distillation per discensum**, patented by William Champion in Bristol in Britain in the 18th century[1]. At Zawar no zinc metal collecting vessels were found in the condensation chamber. But it stands to reason that 36 vessels were placed, one underneath each retort to collect and condense zinc vapor.

The furnace structures unearthed at Zawar did not include their roof part. However, curvature of their extant brick walls suggests that the furnaces probably had domed roofs with a chimney-like opening at the top. This opening would have served two purposes : (1) It would have acted as an outlet for the flow of hot gases generated within the furnace; and (2) it would have also facilitated continuous feeding of the furnace with fuel. The delicate nature of the thin-walled, small clay retorts suggests that the fuel used was light but efficient. No charcoal chunks or wooden pieces could have been used. Use of charcoal powder would have blocked the flow of hot gases from the furnace. It is, therefore, possible to observe that only light, thin cow dung cakes could have been used as fuel. Cow dung cake fire can quickly reach a high temperature and also maintain it for a long period if there is constant supply of fuel as well as oxygen Oxygen flowed into the Zawar furnace through an induced draught.

When the furnace was lit, the hot gases that formed within the furnace rose up and passed out through the top outlet, including a natural draught of air into the furnace.

1 Tylecote, R. F., A History of Metallurgy, London, the Metals Society, 1979

Fresh air flowed into the furnace through the front opening in the condensation chamber and the smaller holes in the perforated terracotta plate separating the condensation chamber from the furnace chamber. Reduction of zinc oxide by carbon is a strongly endothermic reaction requiring 57 k calories of heat. This heat has to be supplied to the smelting charge placed within the retorts. The furnace temperature therefore has to be of the order of 1250°C. A continuous supply of fuel and a strongly induced draught are necessary to maintain this high temperature. The heat generated in the furnace had to be efficiently transferred into the retorts. Therefore, the retorts used at Zawar had to be small thin-walled, made of a locally available, inexpensive refractory material.

Distillation Procedures

RETORTS—The zinc distillation retorts used at Zawar are all small, cylindrical, 25 to 30 cm long, 10 to 15 cm in diameter, made by hand, of locally available river bank clay. One end is tapered and pointed, the other is luted to a cone-shaped clay funnel. Before luting the clay funnel the retorts were filled with the smelting charge. An analysis of the spent charge from the retorts[1] has broadly suggested the composition of the smelting charge.

SMELTING CHARGE—It is significant that the analysis

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1. Freestone, I. C., P. T. Craddock, K.T.M. Hegde, M. J. Hughes & H. V. Paliwal, Zinc Procuction at Zawar, Rajasthan. In P. T. Craddock & M. J. Hughes, editors, **Aspects of Early Furnaces & Smelting Technology**. London, British Museum. (In press).

of the spent charge revealed no evidence of sulphur. The zinc ore at Zawar is a sulphide, sphalerite, occurring as veins in an impure dolomite host rock. It now appears that prior to distillation the ore was roasted to convert it to zinc oxide. Roasting of sphalerite ($2\,ZnS + 3\,O_2 \rightarrow 2ZnO + 2SO_2$) is also *partially an endothermic reaction requiring* temperature of the order of 900°C. Soon after the oxidation reaction sets in, sulphur in the ore supports combustion. However, to produce a dead roast, free from sulphur, a higher temperature of the order of 1000°C is necessary[1], it is not clear how this roasting was accomplished at Zawar. The light weight of zinc oxide makes this process none too easy. In the process or roasting at Zawar, associated dolomite $CaMg(CO_3)_2$, was dissociated into calcium and magnesium oxides. The high MgO and CaO composition of the spent charge is a clear indication that a high proportion of calcined dolomite was included in the smelting charge. Analysis of the spent charge also revealed the presence of potassium, alumirium, manganese, silicon, sodium, and chlorine. Among these the first four elements are likely to have been derived from the ore and its associated gangue. *However, the presence of over 7 precent of soda and traces* of chlorine in the spent charge is less easy to explain. It is not likely that they were also derived from the ore. It is more likely that common salt was added to the smelting charge. It may be of interest to note that in a 14th century

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1. Dennis, W. H , **Metallurgy of the Non-Ferrous Metals.** London . Sir Issac Pitman & Sons Limited, 1961.

text, Rasaratnasamuccay[1] medieval Indian iatrochemists specify common salt as one of the ingredients in the distillation of zinc.

Inclusion of salt in the smelting charge would serve the zinc distillation process in two ways. First, it would help to sinter calcium and magnesium oxides and hence keep the charge within the retorts in a porous open texture. This would minimize the chance of zinc vapor getting trapped in any one part of the retort and forcing that part to burst open. Secondly, soda vapor would react with the silica and alumina of the clay in the interior surface of the retort wall to produce a thin film of glaze. This glaze would prevent the loss of zinc vapor through the micropores in the thin clay wall of the retort. It is perhaps no coincidence that common salt was included in the smelting charge of the distillation per descensum process patented by William Champion.

SMELTING FUEL–The analysis of the spent charge did not give any clues to indentify the fuel that was used for reducing zinc oxide and also producing an excess of carbon monoxide Shukla, however, mentions a number of carbonaceous ingredients used in the smelting charge of the zinc distillation process.. They include turmeric, resin, soot, lac tree, mustard and ghee (clarified butter). The spent charge in the Zawar retorts resembles a mass of small 1 cm^3 balls loosely fixed together. The organic ingredients above,

1. Shukla, H., Rasaratnasamuccaya, Volume 1., Lahore : Meharchand Lachmandas, 1928.

as well as providing carbon monoxide, the necessary reducing agent, would have also served to stick zinc oxide powder together to form pellets. Pellets would create an open texture and also increase the surface area of reduction – reaction. When zinc vapor was produced it flowed down along with an excess of carbon monoxide, into the metal collecting vessels placed in the condensation chamber. There the vapor cooled down, under carbon monoxide, to form a fine powder of metallic zinc.

CHANNELIZING ZINC VAPOR.—All spent retorts when freshly cut open show a clear cylindrical channel at the center through the spent charge. This channel was provided to facilitate the free flow of zinc vapor through the luted funnel condenser tube, down into the condenser vessel. It appears a cylindrical reed of 1.5 cm. diameter was inserted into the retort after it was charged and the funnel part was luted on it. This reed helped to keep the charge within the retort when it was inverted and placed in the furnace. When the furnace was fired the reed burnt away leaving behind a cylindrical flow channel for the zinc vapor to flow freely out of the retort.

DISTILLATION TEMPERATURE—The walls of the clay retorts are highly vitrified, bloated and distorted. Their examination under a scanning electron microscope, suggests that the retorts were heated at a high temperature of the order of 1250° C. Such a high temperature, it appears, was reached and maintained for several hours in the

Zawar zinc distillation furnaces.

Conclusion

Production of zinc presents special problems because the boiling point of the metal is lower than the minimum temperature necessary for extraction of zinc from zinc oxide. Thus zinc has to be produced as a vapor. This vapor will readily reoxidize in air. Therefore distillation of zinc requires a retort, a condenser and a reducing atmosphere. Radiocarbon assay of timber supports found in the galleries of old sphalerite mines has given 2120 ± 60 B P. and 1920 ± 50B.P. dates for the early stages of zinc ore mining and smelting industry at Zawar. With this in mind the salient features of the zinc distillation industry at Zawar may be summarized as follows: (1) It appears that zinc ore mining and smelting industry at Zawar began in the midcenturies of the first millenium B.C. Both the mining and smelting operations were laborious and laborintensive. (2) Sphalerite with impure dolomite was mined crushed, concentrated and roasted to convert the starting materials to oxides. (3) The smelting charge was rolled into pellets of 1 cm^3. It included about 7 percent of common salt and a large quantity of carbonaceous matter. (4) The charge was loaded into small, thin-walled clay retorts, and funnel-like condenser tubes were luted on them with clay. (5) Cylindrical reeds were inserted into the charged retorts through the funnel tubes to keep the charge within the retorts when they were inverted and placed vertically upright in the furnace. In the heat of the furnace, the

reeds burnt away yielding clear flow channels for the zinc vapor to flow out of the retorts. (6) The retorts were heated externally at 1250° C or more in specially designed furnaces. Zinc vapor was collected and cooled under carbon monoxide in condenser vessels placed in the condensation chamber of the furnace. (7) It is likely that 300–400 grams of zinc powder were extracted per retort. (8) It is interesting to note that Zawar was the first site to yield zinc distillation furnaces and retorts. Nowhere else in the world has such structural evidence of zinc distillation in the past been reported so far. (9) The technology revealed at the site is so sophisticated that it would be interesting to know the preceding experimental stages of this industry. (10) Continuous production of zinc at Zawar made brass a popular alloy in India. Even today in Indian village folk are justly proud of rows of glittering brass vessels in their homes.

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Appendix-2

Technical Studies in Copper Artifacts Excavated From Ahar

Karunakara T. M. Hegde

This study is aimed at bringing to light the following aspects concerned with the copper artifacts and the metallurgical slag like material recovered from the Period I levels at Ahar :

(1) Probable sources of the raw material from which copper was extracted,

(2) Whether Ahar was a copper smelting centre in the Chalcolithic Period,

(3) Techniques employed in extraction of the metal and the quality of the metal extracted, and

(4) The processes employed on the solid extracted metal for the production of useful artifacts.

1. Spectroscopic analysis of the selected artifacts and the sample of copper ore obtained from the ancient mine of Khetri was carried out to determine the constituent elements of the specimens. Hilger Glass spectrograph was used in the analysis.

2. Systematic Quantitative Chemical Analysis of the artifacts, samples of the slag-like material and the copper ore sample was carried out to determine the percentage composition of the specimens. Gravimetric and Colorimetric methods were used in this analysis. Unicam SP 1400 was used in the colorimetric analysis.

3. Metallographic examination was carried out on a sample cut from the representative artifact in order to elucidate the internal microstructure of the metal. Universal Karmera Mikroskop was used for observing and photographically recording the microstructures.

During the excavation of the Period I levels at Ahar in 1961-62, four socketless flat copper axes, a small thin copper metal sheet and a few fragments of copper rings were recovered.[1] From among these objects one axe and the metal sheet were selected for this study.

The axe selected bears the registration number. A 2255. It was recovered from Trench A, Layer 13. The axe is rectangular in shape, but has a crescent-like cutting edge. The latter is gradually sloped on both sides of the artifact. Before taking a sample for its metallurgical study, the specimen weighed 236.520 gms. It is 12.7 cms. long, 8.4 cms. broad at the centre and 10 cms. at the cutting edge. It has a maximum thickness of 0.5 cm.

The copper metal sheet bears the registration number A. 2326. It was also recovered from Layer 13 of Trench A.

1. Sankalia, H.D, Prehistory and Protohistory of India and Pakistan, Bombay, 1962, P. 190

In its present condition it is almost rectangular in shape, measuring 5.6 cms in length and 4.5 cms. in breadth. It is however, fragmented in such a way, that it is not possible to visualise either its original shape or function. The maximum thickness of the sheet is 0.1 cm. Before cutting a sample for its analytical study, it weighed 8.732 gms.

A sample piece cut from the butt end of the axe was subjected to spectroscopic analysis, quantitative chemical analysis and metallographic examination. The metal sheet was subjected to spectroscopic analysis and quantitative chemical analysis. It was not subjected to metallographic examination as it was not possible to determine the shape and purpose for which it was intendad in antiquity.

Sources of Raw material

Ahar is situated in the midst of extensive Chalco-pyrite copper ore deposits in the Aravalli region. Khetri, Babai, Singhana, Dariba, Devbari, Delwara and Kotri are a few important names of the sites of the ore deposits in the region. Among them, the latter three sites are situated within a radius of twenty miles from Ahar. At Khetri, Babai and Singhana the ore deposits are associated with ancient mining and metal smelting. It is quite likely that these locally available ore deposits were exploited during the Chalcolithic Period for the production of copper artifacts recovered from Ahar.

In order to probe this possibility, samples cut from the artifacts and a sample of Chalco-pyrite copper ore obtained from Khetri were subjected to spectroscopic analysis. The samples cut from the artifacts were small pieces of 2 cms./ 0.2 cm /0.2 cm. measurements. Spectroscopic analysis brings to light the presence of various elements in the specimens, though some of them are very minor constituents, being present only in very minute traces.

Minute traces of various elements present in ancient metal artifacts are of great significance. These elements are impurities or chance inclusions in the metal obviously, they could not have been fused into the metal by the ancient metallurgist. The impurities are drawn into the constitution of the extracted metal from the raw material from which it was extracted. Therefore, a comparative study of the impurity pattern of metal artifacts and the impurity pattern of the likely ore deposits can help to trace probable sources of the raw material from which the metal was extracted.

When copper is smelted from an ore, normally elements like silver, gold, tin, nickel, lead, cobalt and bismuth pass on to the extracted metal, if these elements are present in the ore, in substantial quantity during the smelting process. Elements like iron, manganess, zinc, aluminium, chromium, molybdenum, vanadium, gadolinium. zerconium, tungsten and titanium also pass on to the constitution of the extracted metal, if they are present in the ore smelted, with however, a great loss in their quantity, as a result of

the smelting process. Often, some of the elements mentioned in the latter set are observed in the extracted metal in very minute traces. Besides these two sets of elements, elements like phosphorus, silicon, calcium, arsenic, sulphur and antimony also pass on to the extracted metal under certain conditions, if they are present in the copper ore smelted.

In the spectroscopic study of the representative Chalcolithic Period copper artifacts from Ahar, all but one of these twenty four elements were sought for in their respective spectrographs. Sulphur was omitted, as it is not spectroscopically recorded. Table of results-I presents the data collected from the spectroscopic analysis of the artifacts and the ore sample.

TABLE OF RESULTS—1

Specimen	Cu	Sn	Au	Ag	Pb	Ni	Co	Bi	Fe	Mn	Zn	Al
Axe	+	nd*	nd	nd	+	+	+	+	+	+	+	+
Sheet	+	nd	nd	nd	+	+	+	+	+	+	+	+
Ore	+	nd	nd	nd	+	+	+	+	+	+	+	+

Specimen	Cr	Mo	Zn	W	Ti	Mg	V	Gd	P	i	Ca	As	Sb
Axe	+	+	+	nd	+	+	nd	+	+	+	+	+	+
Sheet	+	+	+	nd	+	+	nd	+	+	+	+	+	+
Ore	+	+	+	+	+	+	+	+	+	+	+	+	+

The analytical data above indicate that the impurity patterns of the artifacts and the sample of ore are almost

* nd—not detected

similar. The process of metallurgy is a chain of events, such as ore dressing, roasting, smelting and finally, purification of the metal. In this chain of reactions, it is but natural to expect many variables that may hinder the direct linking of the ore with metal. Nevertheless, from the above analytical data it is possible to indicate that the copper metal of the artifacts recovered from Ahar was probably smelted from the chalcopyrite ore of the Aravalli region. Further spectroscopic studies in more Chalcolithic Period metal objects excavated from the region and more ore samples of the region will probably prove this point. For the present, the author had to content himself limiting his studies to these available samples. Requests have been made to colleagues in the field for samples of artifacts and ore deposits for further work.

Analysis of the Slag-like material

During the excavation of Period I levels at Ahar, heaps of slag-like material were recovered along with copper artifacts The slag-like material was found in the trench in specially made round pit of about one-and-a half feet in diameter[2]. It is not known whether this pit was a part of a furnace.

For the purpose of this metallurgical study, three samples of this slag-like material, collected from three different layers were subjected to quantitative chemical analysis. The samples were thoroughly washed in distilled water, dried in air, powdered separately and then dried in oven at 110°C for twenty-four hours. The percentage composition of the samples is given in the page no. 17 :

2. Op cit, P. 194.

The analytical data above, clearly indicate that the samples are of copper metallurgical slag. This fact has great significance. The presence of remains of copper-smelting industry in the form of metallurgical slag along with copper artifacts, in the Chalcolithic layers at Ahar shows that Ahar was probably a Chalcolithic Period copper-smelting centre. The fact that the slag was recovered from more than one trench at three different depths, in the course of a restricted excavation of a vast archaeologicol deposit, further shows that the copper-smelting industry at Ahar was probably extensive.

During the last decade and a half more than a dozen Chalcolithic sites were dug out in Western India and Central India and Northern Deccan. But so far, no other site except Ahar has yielded remains of Chalcolithic Period copper metallurgy. The industry during the period was restricted. Certainly it was not as widespread as the artifacts of the metal. In this connection the following observations may be interesting.

During the Chalcolithic Period, the location of a metallurgical centre must have been determined by two factors, namely (1) proximity of the ore deposits and (2) availability of abundance of fuel. It is obvious that transportation of these vital materials over vast distances was beyond the rudimentary resources of the people, The Aravalli region amply satisfied both these conditions. It is quite probable that there were many copper-smelting centres in the region

and Ahar was one of them. The discovery of a large number of "Ahar Ware" sites points out to this possibility. Though the number of copper artifacts recovered at Ahar was small, stone tools were totally absent there A horizontal excavation of the site of Ahar and vertical excavation of a few of the 'Ahar Ware' sites, are bound to throw more light on the Chalcolithic Period copper-smelting industry of the region.

Techniques employed in extraction of the metal and the quality of the metal extracted

The analytical data of the slag mentioned above shows a very high percentage of silica in the composition of the slag. This is not without interest to this study. It indicates the probability of fluxing the copper ore.

While smelting copper from chalco-pyrite ore, if silica is mixed with tha crushed ore, it acts as a fluxing agent and hence promotes fluidity In the smelting charge, lowers the fusion temperature of the ore and facilitates the removal of impurities from the extracted metal. The impurities are separated out in the form of slag. In the copper smelting industry, some of the usual fluxing agents employed are lime, calcium phosphate, calcium sulphate, barium sulphate and silica. The fluxing agent chemically unites with the gangue of the ore to form fusible silicates—the slag.

In this connection, the high percentage of silica in the composition of the metallurgical slag recovered from Ahar is interesting. It may be due to deliberate addition of silica

during the smelting process as a fluxing agent or it may be a part of the ore mass. However, a quantitative chemical anal/sis of the sample of copper ore from Khetri indicated 16.70% silica in its composition. This is less than half of the percentage of silica in the slag. Therefore, it is quite probable that the copper ore was fluxed with silica during the Chalcolithic Period.

An analvsis of slag heaps situated in the eastern Alps which ware the remains of ancient copper-smelting has also brought to light fluxing of the copper ore with silica. This copper metallurgy is dated to circa 1700 B.C.,[3] a period contemporary with the Period I of Ahar.

Quantitative Chemical analysis of the artifacts gave the following data.

TABLE OF RESULTS—3

Elements	Percentage Compositions	
	Axe	Sheet
Cu	90.92	96.28
Sn	—	—
Fe	6.48	1.22
Pb	1.62	1.64
Zn	tr●	tr
Co	tr	tr
Ni	0.31	0.26
As	tr	tr
Bi	tr	tr
Mn	0.23	0.31
S	tr	tr

3. Singer, C, et al, A History of Technology, Vol I, Oxford 1954, P. 589

● tr—traces

From the analytical data above, it is possible to observe that the metal of the axe is highly impure. Among other things, it contains 6.48% of iron. Complete removal of iron from copper while the metal is extracted from Chalco-pyrite ore is a problem. One of the conditions necessary for complete removal of iron from the metal is high temperature of the smelting furnace, over 1200°C. It is necessary to produce separate liquid slag and liquid metal. Since the partition coefficient between the slag and the metal also varies with the composition of the smelting charge, that is, the mixture of ore powder, fluxing agent and the fuel, it is not possible to indicate here, whether the high percentage of iron in the metal of the axe, was due to inadequate temperature of smelting furnace or faulty composition of the smelting charge.

However, this inefficient extraction of copper at Ahar was probably an exception; it was not a rule. The percentage composition of the metal sheet clearly indicates that in the extraction of the metal from which the sheet was made, iron was substantially eradicated. The percentage of iron in this specimen is only 1.2 and about one percent of iron in the composition of Chalcolithic Period copper artifacts has been shown to be common in a study of such artifacts excavated from Navdatoli, Chancloli and Somnath.[4]

4. Hegde, K.T.M., Technical Studies in Chalcolithic Period Copper Metallurgy, Baroda, 1965, Ph.D. Thesis, M. S. University of Baroda Library, pp. 97-125.

Furthermore, the analytical data above show that both the specimens contain only a negligible quantity of arsenic and sulphur. This is not without significance as it indicates thorough roasting of crushed ore before it was smelted. Arsenic is a common impurity in copper ores. Percentage of arsenic in certain copper ores like enargite, tennantite and famatinite is very high. Even in Chalco-pyrite, percentage of arsenic can be considerable. The sample of Chalco-pyrite ore obtained from Khetri showed 4.28% of arsenic. If the crushed ore is roasted at a comparatively high temperature, above 500° C, over a prolonged period of time, arsenic and sulphur in the ore get volatilised.

It is but necessary to ensure thet arsenic is not present in large quantity in the extracted metal. When this element constitutes more than two percent in copper, the metal becomes brittle. Since the metal was primarily used for the production of cutting implements during the Chalcolithic Period, presence of more than two percent of arsenic in the metal, would have rendered it unsuitable for the purpose for which it was mainly intended.

Presence of 1.62 to 1.64 percent of lead is also indicated in the above analytical study. As pointed above, lead passes on to the extracted metal if it is present in the ore smelted. It is also possible to observe here that such a small quantity of lead as is present in the specimens under

study, was not deliberately added by the ancient metallurgist. Deliberate fusion of lead in copper intended for producing cutting implements is out of place as it renders the resulting alloy softer than copper.

Copper by itself ia a soft metal and to render it more suitable for the production of cutting implements, it was alloyed with tin even during the Chalcolithic Period. Such instances of deliberate alloying of copper with 3.12 to 12.82 percent of tin was revealed in a study of the implements excavated from Navdatoli and Somnath.[5]

Inter alia, the chemical composition of the objects under study also indicates the presence of nickel,, zinc, cobalt, bismuth and manganese in very small quantity. Like lead, these elements are also chance inclusions in the metal, derived from the copper ore smelted.

Techniques employed in the production of artifacts from the solid metal

There are four methods available for the purpose of producing useful copper objects from the solid metal They are (1) forging from solid piece of the metal; (2) melting the metal and casting it to required shape; (3) fabrication, that is, building up an object from thin metal plates, secured to each other by means of rivets; and (4) sheet metal working.

5. I. bed.

that is the object is fashioned out frcm a single metal plate, by means of sinking, raising or spinning. Which of these four methods were employed in the production of the axe excavated from Ahar ? To seek an answer to this question, a metallographic examination of the object was carried out.

Metallographic examination reveals whether the object was cast or wrought. what heat treatment it was subjected to in antiquity, whether it is porous or brittle and what metallic and non-metallic inclusions it possesses. There will be defined on the metallographic surface, such structural characteristics of the metal as grain size, the size, shap and distributions of secondary phases, segregations and other heterogencus conditions All these characteristics profcundly influence the physical properties of the metal.

The axe selected for this study, has a rough uneven corrugated surface finish. Casting fins on the surface of the object are apparent. These surface features of the artifact indicate that it was probably cast in a crude sand mould. A sample for its metallographic examination was cut from the butt-end, as its cutting edge could be expected to be cold worked while the axe was in use.

The sample was first polished in the longitudinal section and was examined at a magnification of × 12. The size and shape of the grains in a cast metal object show up more

completely in the longitudinal section than in the transverse section.

The polished surface of the metal showed dendritic segregations, prosity due to gasholes, cracks and globular gray inclusions.

Some of these inclusions, particularly those concentrated around the porosity holes turned red under polorised light, while the others remained gray.

From the above observations, it is clear that among the inclusions of the metal, there are cuprous oxide and lead. As pointed out above, lead was not deliberately added to the metal, it was a change inclusion, derived from the ore from which the metal was extracted. In copper, lead does not form a solid solution. instead finds itself distributed in the form of globules of gray colour. These globules do not turn red under polarised light. The gray globular inclusions that turned red under polarised light are due to the presence of cuprous oxide in the metal.

The metal is porous and cuprous oxide is found concentrated around the porosity holes. Porosity had resulted due to inadequate ventilation in the mould for escape of gases evolved as the molten metal was poured into the mould. The evolved gases were trapped within the metal, giving rise to gas holes, formation of cuprous oxide and porosity. The

technique of venting the mould to allow for free escape of the evolved gases is the secret of successful casting in copper. Evidently, the technique of venting the mould was not employed at Ahar while this axe was cast,

The photo-macrograph also indicates the presence of grain boundaries of the metal, on the edges of the sample, in the polished condition itself. This is due to corrosion of the surface of the metal. Corrosion is observed to be moving inwards, into the interstices of the metal in an intergranular manner.

The polished surface of the metal was etched in a mixture of ammonia and hydrogen peroxide solution for seventyfive seconds. The etched surface was observed at a magnification of × 240.

The microstructure of the metal showed dendritic as well as cellular structures and coring. Presence of dendrites and coring is an indication of the east condition of the metal. When a mass of liquid copper solidifies under slow cooling conditions, it has been observed that the process of solidification does not begin at one particular moment at all the points, throughout the entire mass of the molten metal. Instead, solidification starts at certain points called nuclei from which crystals grow rapidly outwards. As a result, each nucleus of crystallisation shapes in a tree-like growth in three dimensions, This growth is known as dendritic growth,

As the solidification process proceeds further, the metal contracts and hence, between the branches of dendrites, fincly distributed voids remain. These voids are known as coring. Dendritic growth and coring are therefore, features of the cast condition of the metal. If the metal is subjected to work-hardening by cold work or hot work and annealing, the dendrites merge into grains and the voids get filled up. The metal specimen under study was left in the cast condition. It was not subjected to work-hardening after it was cast. In order to study the metal further, the sample was polished in the transverse section. The polished surface was examined at a magnification of X 12.

The polished surface of the metal showed heterogenity, segregation of dendrites, gray globules, porosity holes and cluster of pits.

The polished surface was etched in a mixture of ammonia and hydrogen peroxide solution for seventy five seconds. The etched surface was examined at magnification of × 120 anc × 675.

Cellular structure is a characteristic of slow cooling of the metal after it was cast. Under slow cooling conditions, the impurities in the metal get concentrated around the cellular grain boundaries.

From the metallographic study of this artifact it is possible to observe that it was cast in a crude unventilated sand or earthy mould and was left in the cast condition; it was not subjected to work-hardening. The presence of cellular structure in the metal indicates that it was slowly cooled after it was cast. Slow cooling of the molten metal in the casting mould was probably brought about by covering the mould under hot ash.

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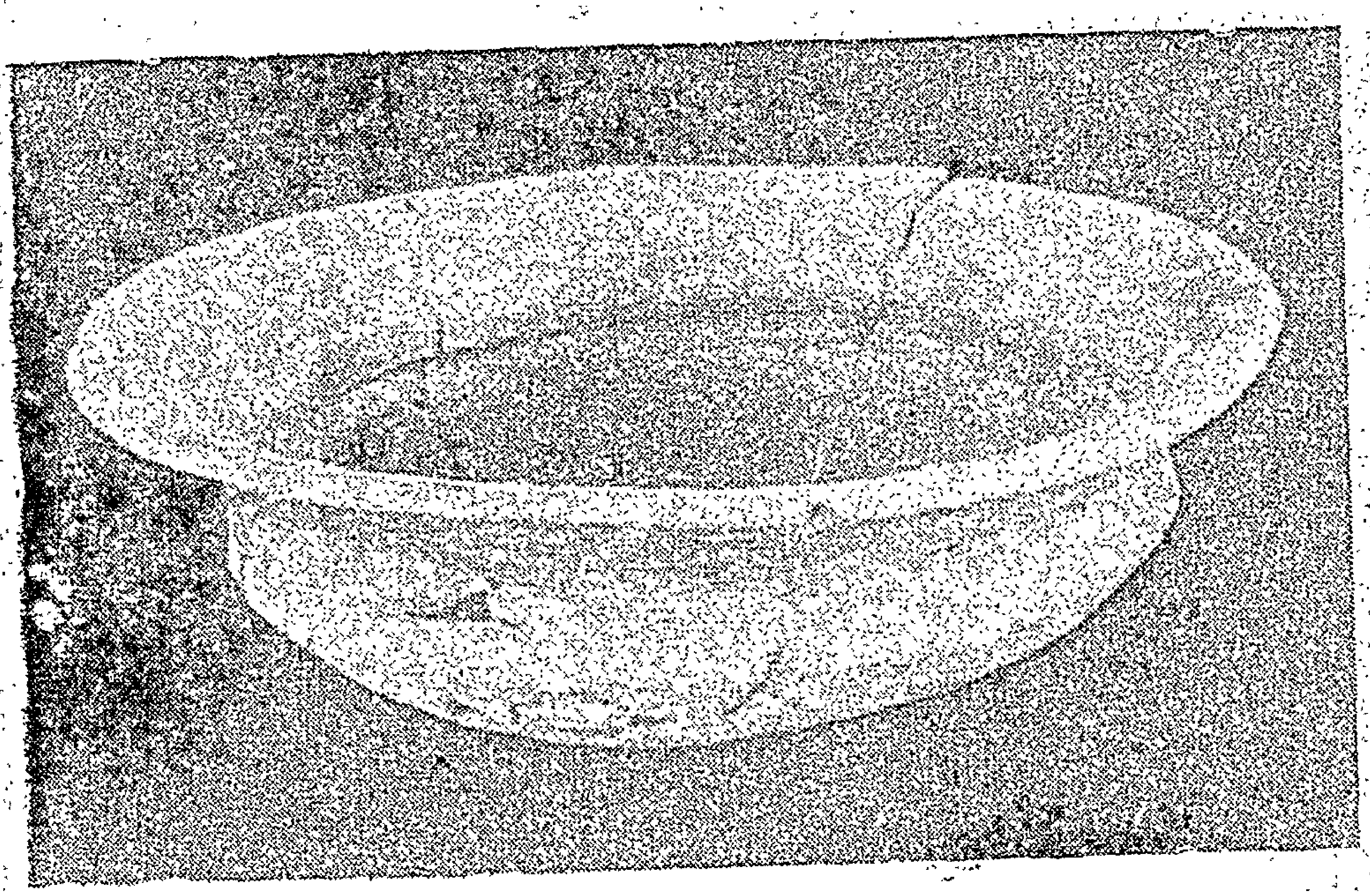
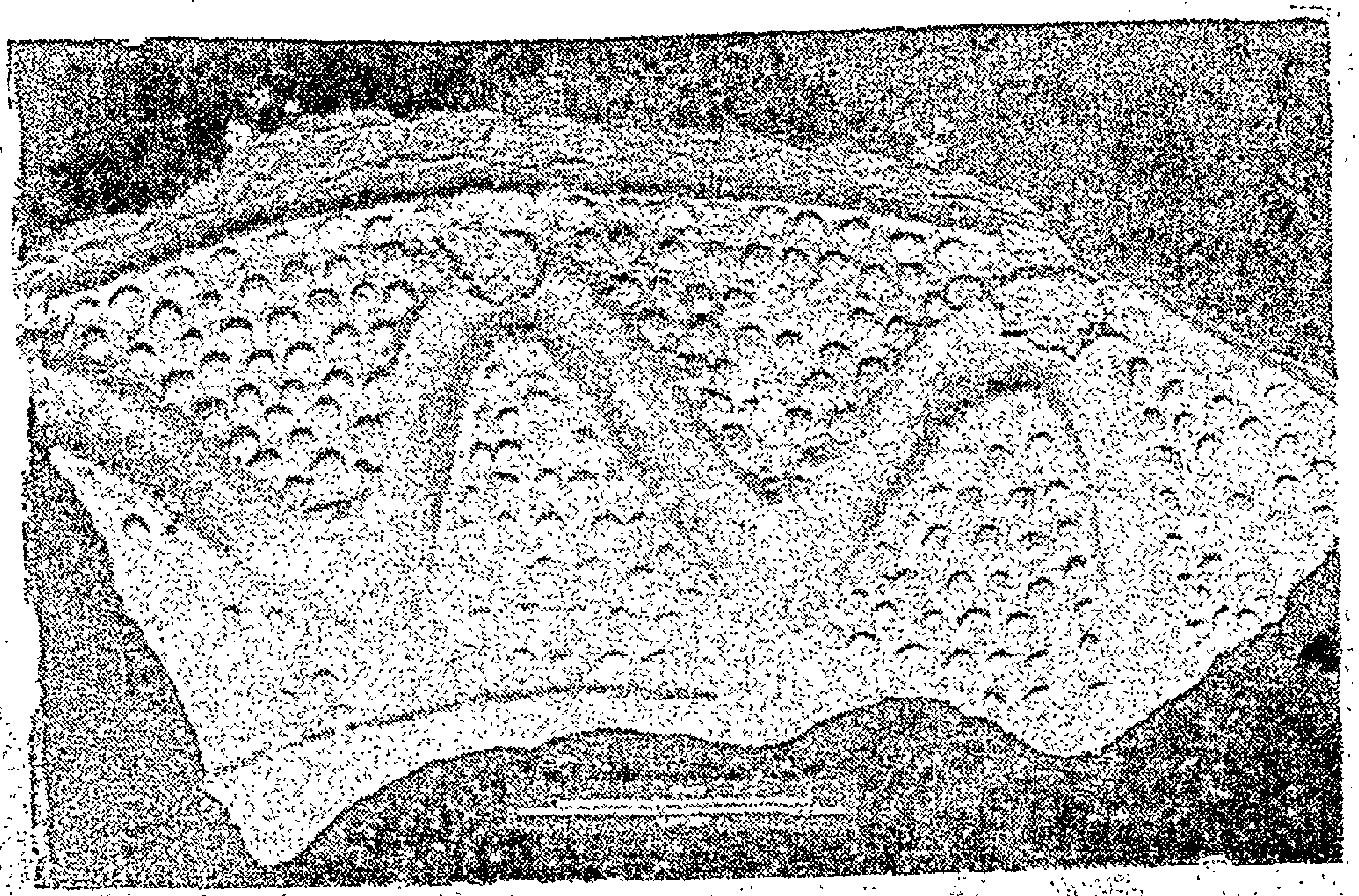


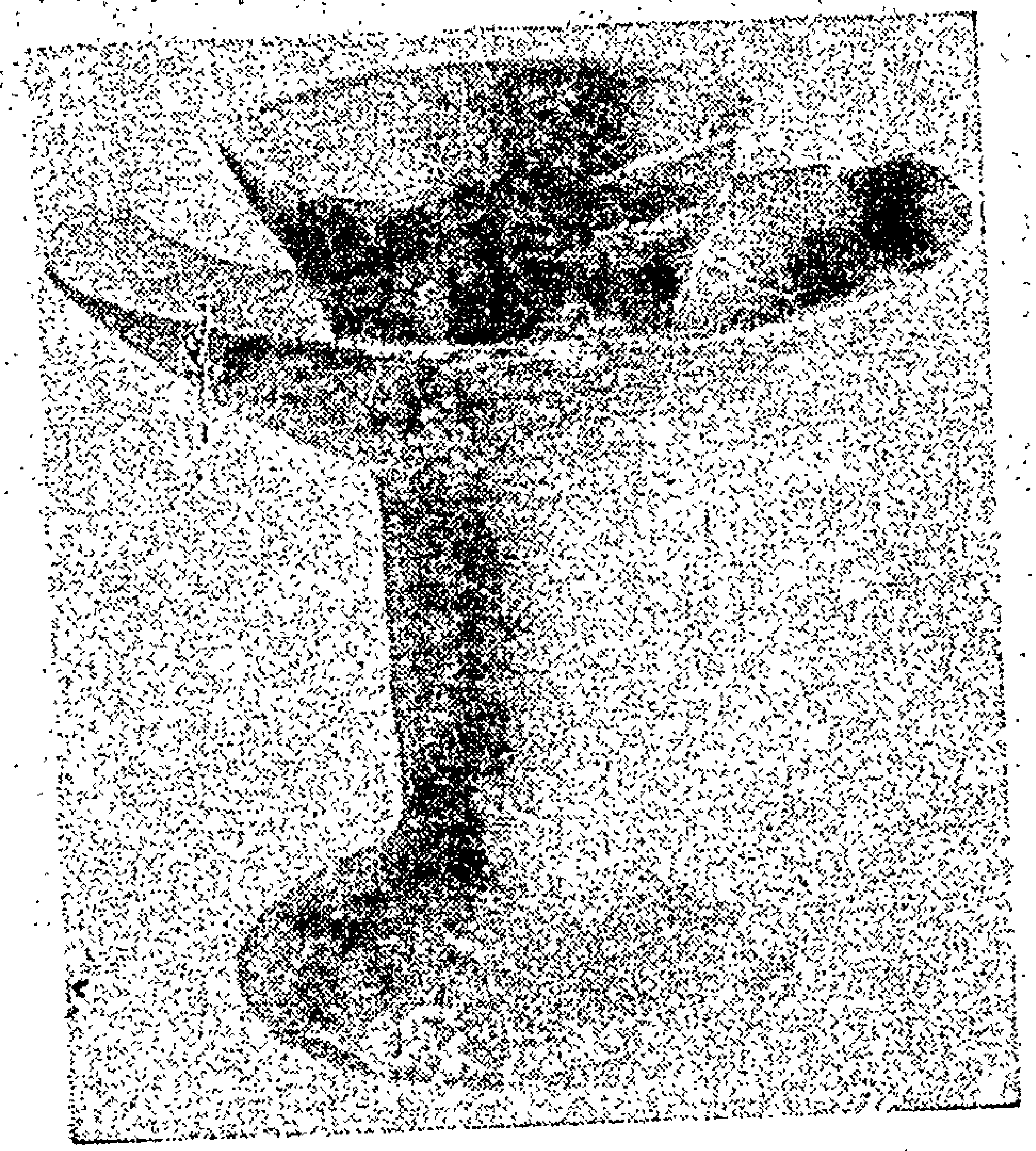
Basin (Tan Ware)



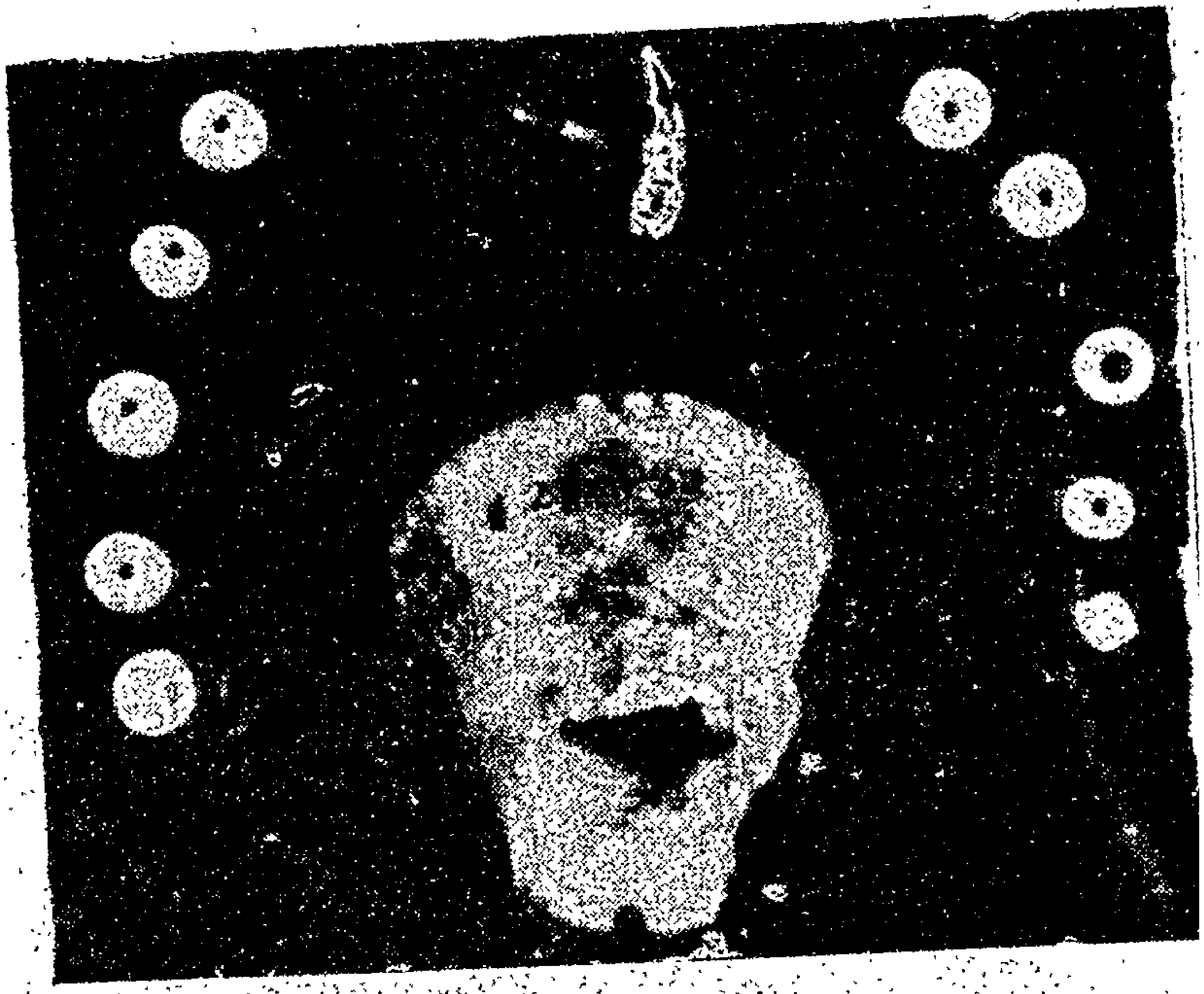
Red Ware Incised & Applique Decoration

Bifacial Scraper

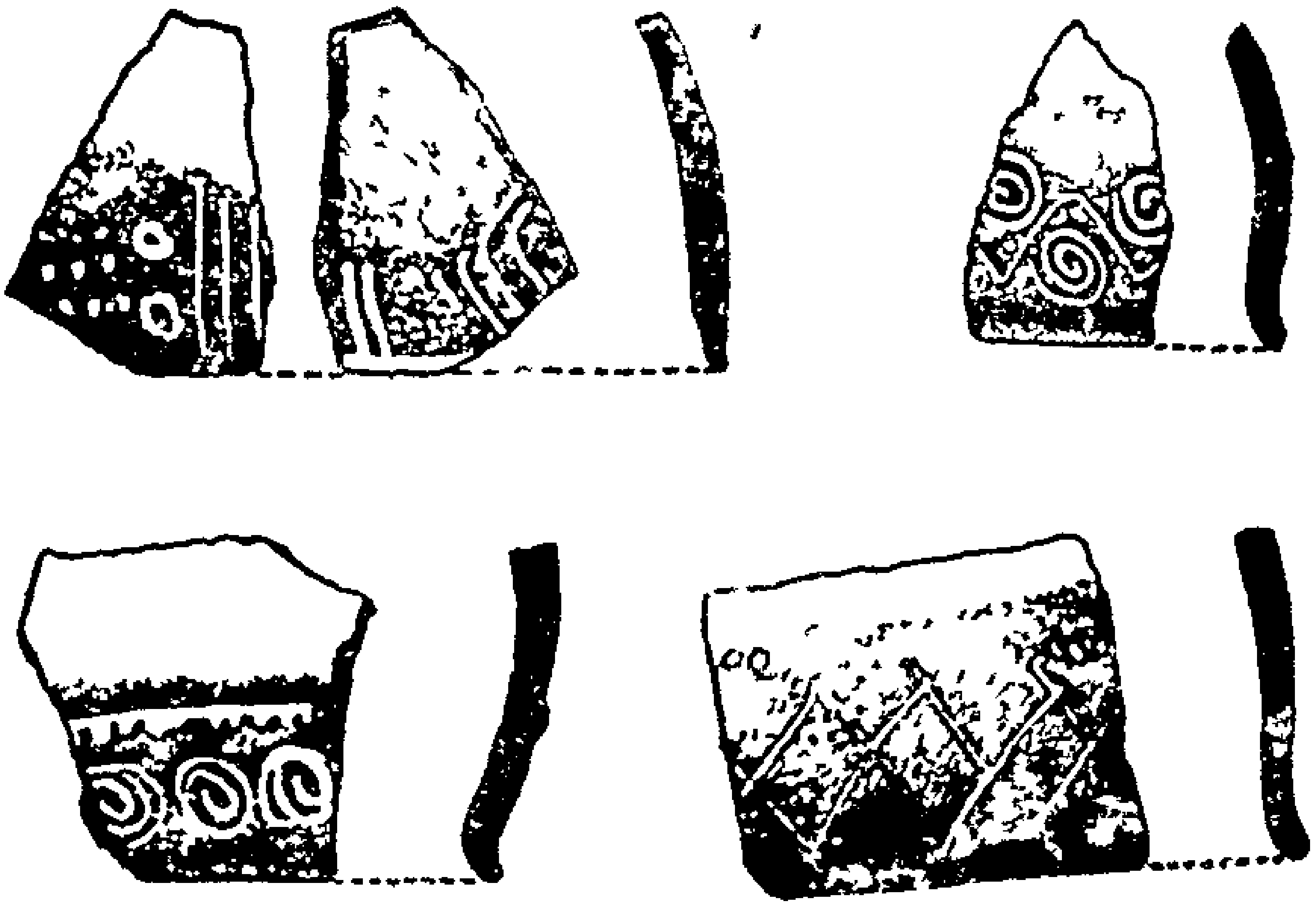
Unifacial Scraper



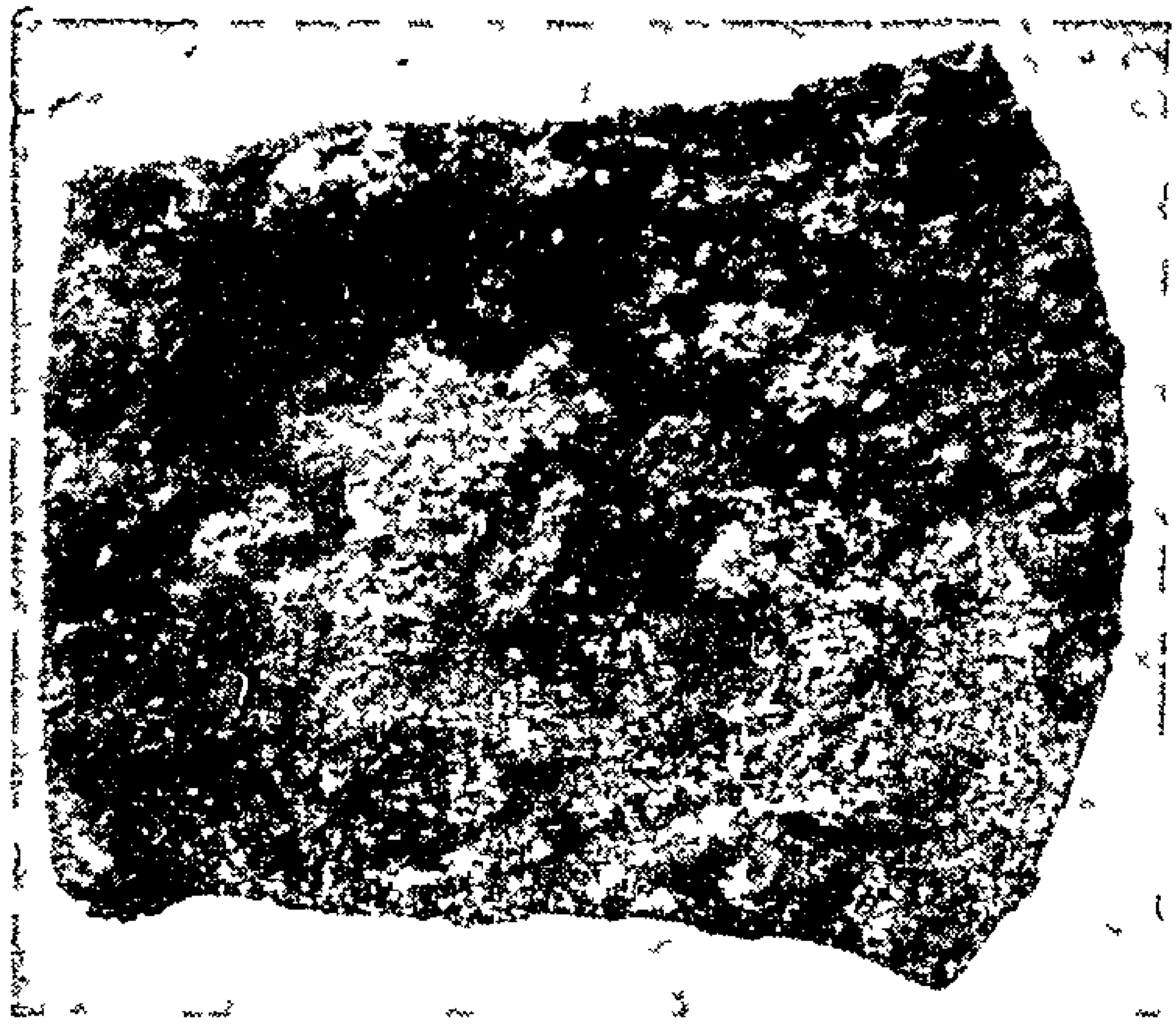
Bowl Cum-Dish-on-Stand



Small Bowl with Agate Beads

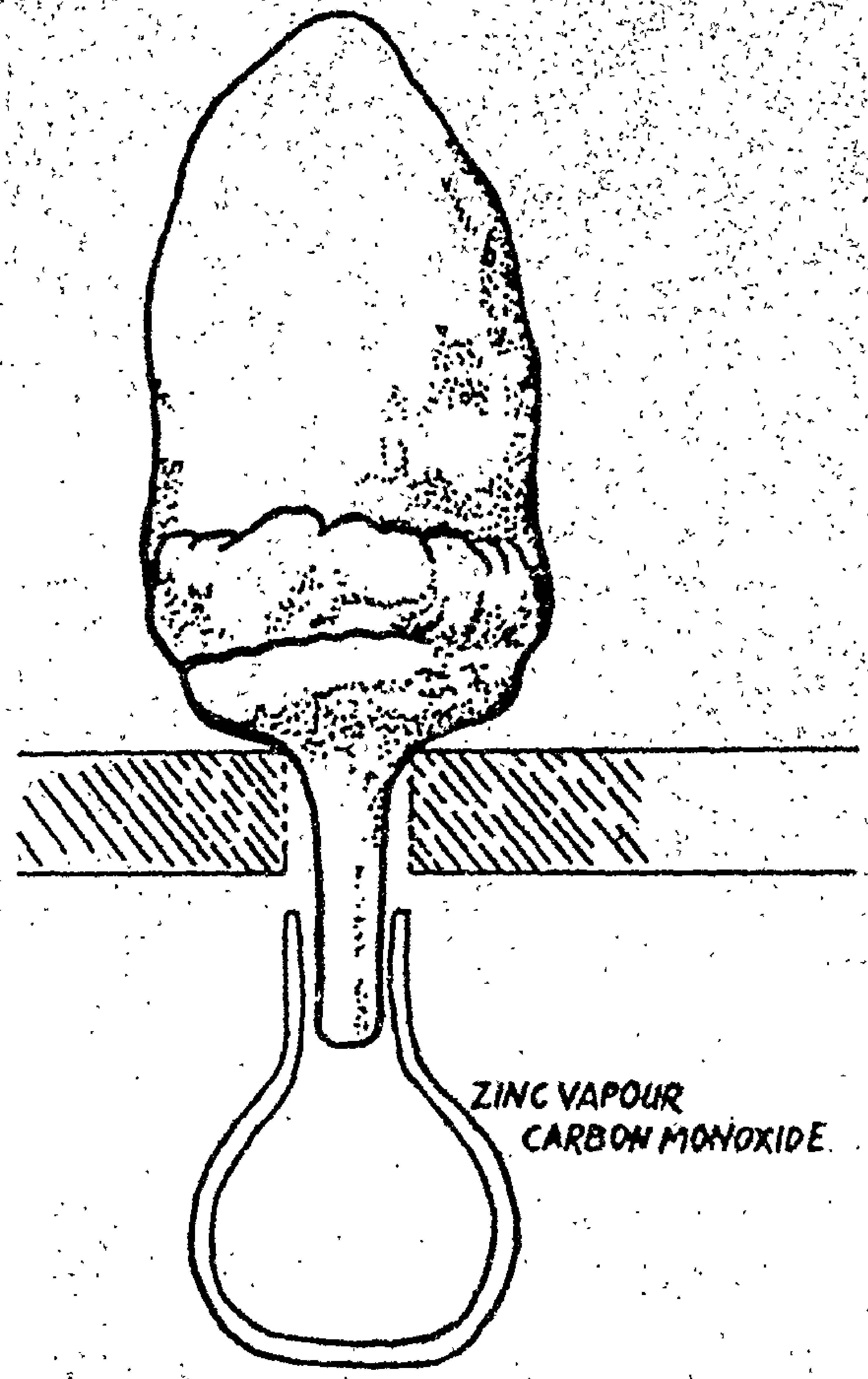


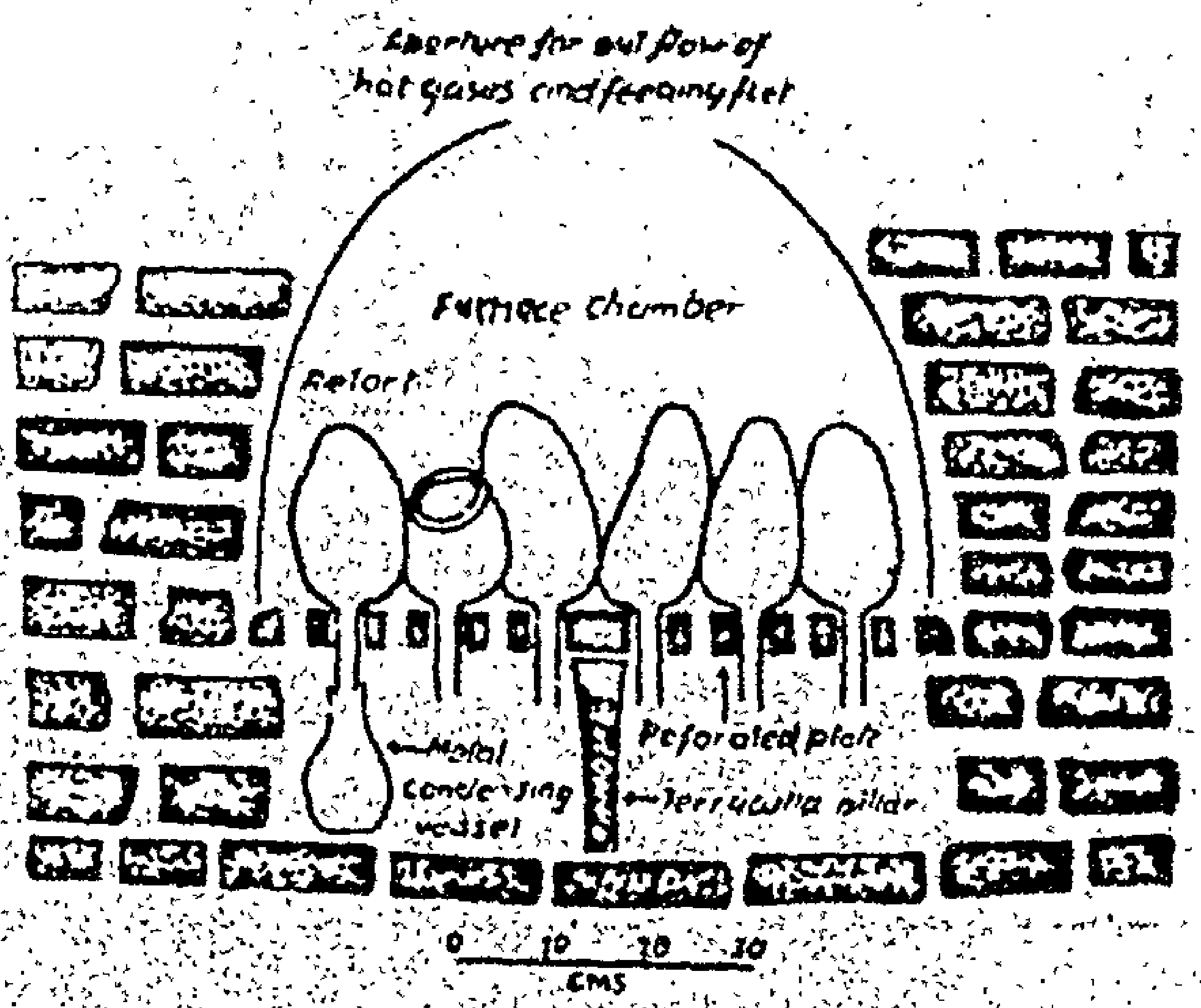
Black & Red Ware (Rimless)



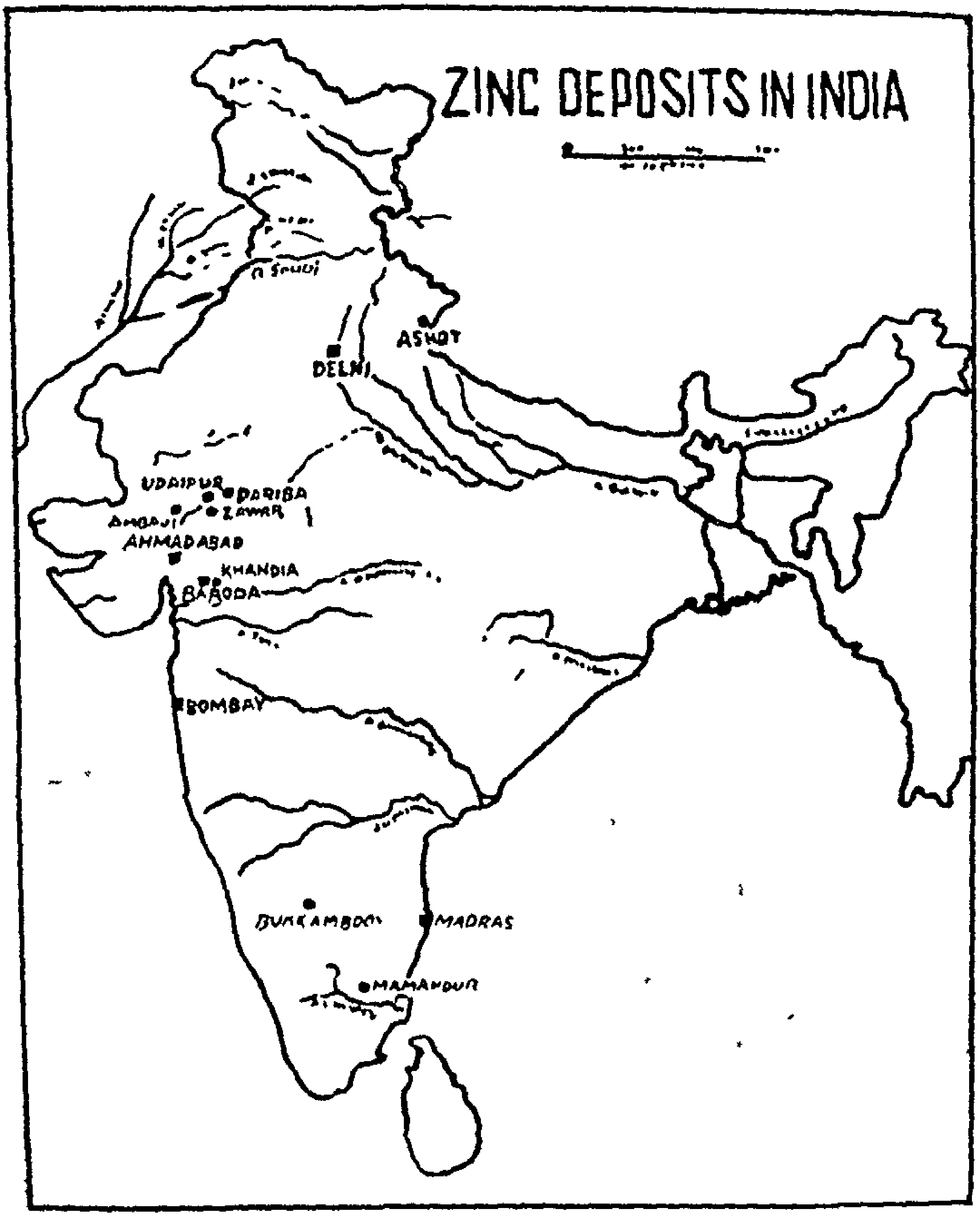
Copper Axe

Zinc Vapor Distillation and Condensation under the reducing atmosphere of Carbon Monoxide.

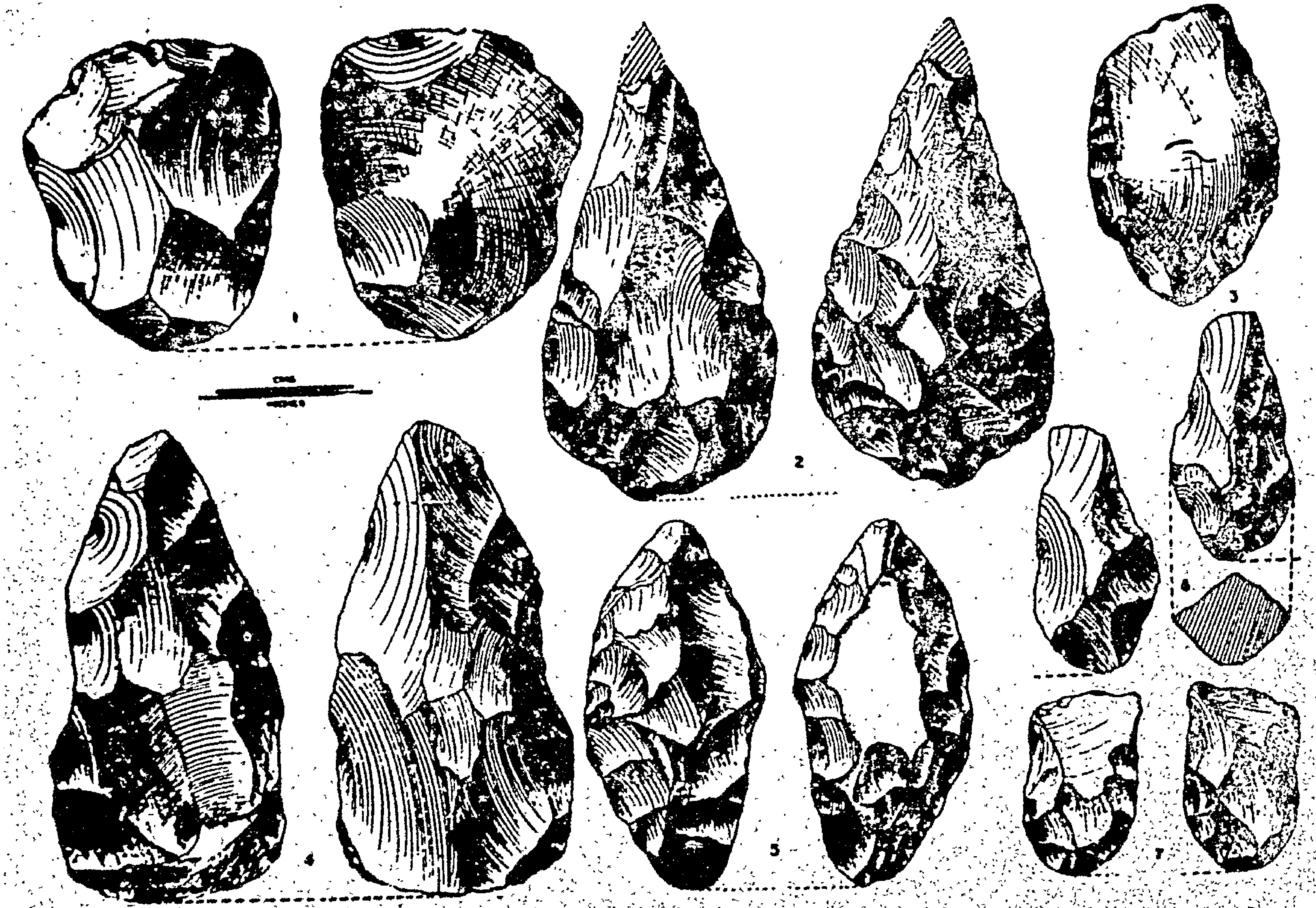




A cross Section of ancient Zinc distillation furnace excavated at Zawar



Map showing zinc deposits in India,
including the location of Zawar



Handaxes & Cleavers